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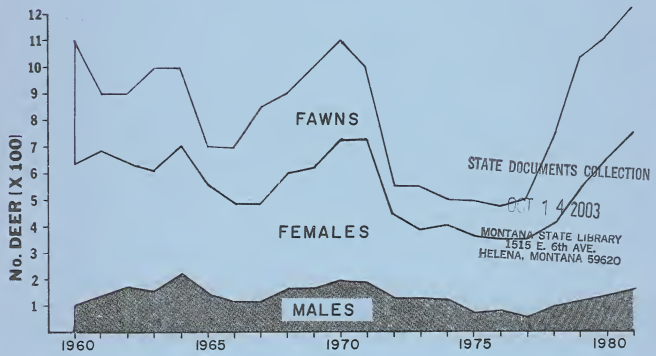

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PROGRESS REPORT FOR THE PERIOD
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JOB PROGRESS REPORT

RESEARCH PROJECT SEGMENT

STATE	Montana		
PROJECT	W-120-R-13	NAME	Statewide Wildlife Research
STUDY NO.	BG-1.0	TITLE	Statewide Mule Deer Ecology Studies
JOB NOS.	1 and 2	TITLES	(Various)
STUDY NO.	BG-2.0	TITLE	Statewide White-tailed Deer Ecology Studies
JOB NOS.	1, 3, and 5	TITLES	(Various)

Period Covered: July 1, 1981 - June 30, 1982

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Since this is a Progress Report only, results presented herein are not necessarily final and may be subject to change. For this reason, the information contained in this report may not be published or used for other purposes without permission of the Director.

ACKNOWLEDGEMENTS

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INTRODUCTION

The statewide deer research program was initiated in July 1975. Background information on problems and needs was given in previous reports (Mackie et al. 1976, 1977, 1978, 1979, 1980, and 1981). Overall objectives were to:

1. provide a more detailed understanding of the population biology and habitat relationships of deer and of the factors influencing deer numbers in the diverse environments in which deer occur in Montana;

2. develop new or improved methods for measuring deer populations and habitat parameters, new guidelines for applying existing information and technology more effectively, and/or new criteria for interpreting field data in terms of management needs; and

3. establish new guidelines for consideration of the habitat requirements and relationships of deer in other game, range, forest, and land management programs and practices in Montana.

Present efforts continue most of the basic studies established during 1975-76, except those on deer in the prairie-agricultural habitats of eastern Montana. This prairie deer study will be reestablished as a graduate (Ph.D.) thesis research project in July 1982. In addition, an intensive study of white-tailed deer on river bottom habitats along the lower Yellowstone River was established during the summer of 1980, and studies of white-tailed deer in northwestern Montana were extended to include another major coniferous forest habitat during 1981-82. Goals and objectives are generally similar to those outlined earlier, except that greater emphasis is now given to testing hypotheses developed from investigations and findings during the 1975-1980 period. Specifically, they are to:

1. further determine basic biological and ecological parameters for mule deer and white-tailed deer in populations associated with the major habitats in which the two species occur in Montana. These include population size/density, reproduction/recruitment, mortality/turnover, sex/age structure, longevity, and physical condition. They also include distribution, movements, use of specific habitat/cover types, food habits, and other behavioral patterns;

2. further relate those basic biological and ecological parameters to characteristics of individual habitats or environments, including topography, physiography, vegetation, weather and climate, and land use, as well as to specific potential limiting factors associated with individual habitats, study areas and populations. Those might include nutrition (forage production, availability, and quality), other wild ungulates, domestic livestock, livestock grazing and associated range management practices, logging and associated forest management practices, agriculture and associated cropping practices, and rural subdivisions and associated human activities. They could also include hunting, predation, diseases and parasites, and weather;

3. further develop and test hypotheses relating to findings; particularly that: natural population regulation in deer is basically effected by interaction between inherent habitat characteristics and inherent requirements and behavioral attributes of the animals; that population phenomena and dynamics are the strategy by which deer populations exploit diverse habitats; and that population dynamics are indicators of basic habitat relationships of deer in the diverse habitats in which they occur; and

4. develop new methods, criteria, and guidelines for deer management including those for: assessing mule deer and white-tailed deer population characteristics in major habitats, assessing important habitat/environmental characteristics; relating population phenomena and dynamics of the two species to habitat/environmental characteristics, and vice-versa; relating population phenomena and dynamics to specific management opportunities or constraints; relating important habitat/environmental characteristics to specific management opportunities and constraints; measuring and/or interpreting the role and importance of various "limiting factors" in deer management programs; and for consideration of the requirements and habitat relationships of deer in other land use and management programs.

This report compiles Job Progress Reports for individual jobs and investigations conducted on intensive study areas or in conjunction with the Statewide Deer Research Studies during 1980-81. The individual reports outline specific job objectives and procedures and present and discuss current findings in relation to information obtained previously. Findings and other information resulting from the studies have also been summarized in numerous separate publications. A listing of these is presentated in an Appendix to this report. Several additional manuscripts were prepared during 1981-82 for submission and possible publication during 1982-83.

STUDY NO. BG-1.0 JOB NO. 1

JOB TITLE: Population ecology and habitat relationships of mule deer in mountain-foothill habitats in southwestern Montana.

ABSTRACT:

Studies to evaluate factors affecting populations of mule deer in the Bridger Mountains were continued during 1981-82. The winter of 1981-82 was characterized by alternate mild and cold periods, with periods of severe weather persisting through April and May. Vegetation production on 6 of 9 macroplots located on summer range was significantly less in 1981 as compared to 1980; the other three macroplots were not significantly different. In early April, 113 deer with recognizable neckbands and radio collars were present on the Armstrong study area, while 36 marked animals occurred on Brackett Creek. Approximately 55 marked deer occurred on the Livingston winter range, 96 on South 16-Mile, 31 on Battle Ridge, and 31 on the Blacktail Mountain winter range. Population data for the Armstrong winter range indicated that 330 deer were present in early winter; the number decreasing to 170 by spring. Overwinter fawn mortality was moderate with the estimated total reaching about 45% of early winter numbers. Adult mortality was estimated to be 14% of the early winter adult population. Observed ratios from winter aerial classifications were 50 fawns: 100 females, 38 fawns: 100 adults, and 32 males: 100 females in early winter and 46 fawns: 100 adults in late winter. The spring fawn: female ratio was 35:100, indicating moderate recruitment. Age structural data indicated that females 8.5 years and older continue to comprise a substantial percentage of the female population. During the 1981 hunting season, an estimated 468 (72%) of 650 either sex permit holders hunted deer in HD312 and 257 killed deer. Hunter success was 55% compared to 56% in 1980. Calculations based on helicopter sampling efficiencies and the total number observed during the late winter surveys indicated a population of 7,315 mule deer for the entire Bridger Range.

JOB OBJECTIVES:

1. To determine basic biological and ecological parameters of mule deer populations associated with mountain-foothill habitats:

2. To relate those basic population parameters to (a) characteristics of individual habitats or environments and (b) specific, potential limiting factors associated with individual populations and habitats, including nutrition, other wild ungulates, domestic livestock grazing and range management practices, subdivisions and associated human activity, weather, and hunting;

3. To further develop and test hypotheses relating to deer-habitat interactions and population regulation; and

4. To develop new methods, criteria, and guidelines for deer management within mountain-foothill habitats.

INTRODUCTION

This report summarizes findings of studies on the population ecology and habitat relationships of mule deer in the Bridger Mountains, Montana, for the period 1 July 1981 through 30 June 1982. These studies have included: (1) intensive studies of the distribution, movements, habitat use and population characteristics of mule deer associated with the Armstrong winter range, and (2) extensive studies of the seasonal distribution, habitat relations and population characteristics of mule deer throughout the Bridger Mountain Range complex. The history and general nature of both efforts were described by Mackie et al. (1978).

THE STUDY AREA

The Bridger Mountain Range (Fig. 1) is located in northeastern Gallatin and northwestern Park Counties, Montana. A detailed description of topographic, climatic and vegetative characteristics of this area, including the location of major mule deer winter ranges and associated seasonal ranges was presented by Mackie et al. (1978, 1980).

METHODS

Habitat Analysis

Habitat parameters measured and general methodology employed were described by Mackie et al. (1978).

Population Studies

Various methods employed in assessment of deer population characteristics have been described in previous reports (Mackie et al. 1978, 1978). During 1981-1982, early winter helicopter surveys (Mackie, Hamlin and Pac 1980) were conducted on 27 December 1981 on the Armstrong study area and Brackett Creek on 5 January 1982. In late winter, all major mule deer winter ranges in the Bridger complex, excluding North 16-Mile, were surveyed on 21-25 March 1982. The Brackett Creek and Armstrong study areas were flown for classification data on 29 April 1982. A separate estimate of mule deer numbers on the Armstrong winter range in spring was developed from ground observations on 15 days during April-early May when a minimum of 50 deer were classified per survey.

Fifty-eight additional deer were bait-trapped and tagged on the Armstrong winter range between 4 January and 12 March 1982. All were marked with "Armorite" neckbands. Included were 11 fawns fitted with both neckbands and expandable radio-collars. A summary of all mule deer tagged on the Armstrong study area from 1972 through 1982 and their status as of May 1982 is given in Table 1. At the end of June, 1982 6 adults and 6 fawns in the Armstrong population wore functional radio collars.

On 24 February, 1982, 33 mule deer were trapped on the Blacktail mountain winter range using a drive net and helicopter (Beasom et al. 1980). Ten adult females were fitted with radio-collars, the remaining deer were neckbanded. The same trapping method was used 24-25 February 1982 on the South 16-Mile winter range to tag 99 mule deer. Thirteen adult females were equipped with radio-collars and the remainder of these deer were neckbanded. On 3 March 1982, 55 mule deer were trapped and tagged using the helicopter and drive net on the Livingston

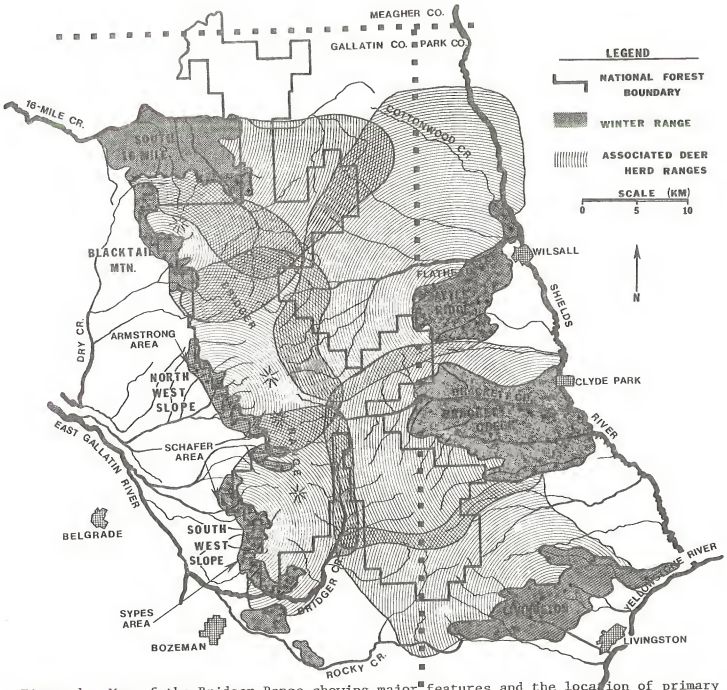

Figure 1. Map of the Bridger Range showing major features and the location of primary study areas.

Table 1. Summary of mule deer trapped on the Armstrong winter range from 1972 through 1982 and their status as of May 1, 1982.

Year	Total Number Marked	Number OK[1] 5/82	Number Dead[2]	Unknown
1972	5	0	4(3)	1
1973	16	1	11(1)	4
1974	39	6	15(3)	18
1975	36	5	23(9)	8
1976	9	2	3(1)	4
1977	16	5	8(2)	3
1978	42	16	14(4)	12
1979	72	21	26(8)	25
1980	24	7	12(3)	5
1981	11	7	1(1)	3
1982	58	45	11	2

[1] Number alive during spring, 1982. Includes one adult male that wintered off the study area and one male fawn that lost collar.

[2] Number shot by hunters in parentheses.

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winter range. Twelve adult females were marked with radio-collars and the remainder were neck-banded. Two additional mule deer were tagged 2 March 1982 on the South16-Mile winter range using the hand-held Net Gun fired from a helicopter (Barrett, et al 1982). One was radio-collared and the other neckbanded.

Information on hunter success, hunter distribution, and the total number, sex and age structure and distribution of the deer harvest during 1981 was determined from a mail questionnaire sent to all 650 special either-sex permit holders in HD 312, which includes the Bridger Range.

RESULTS AND DISCUSSION

Habitat Studies

Weather Conditions on Major Winter Ranges

The winter of 1981-82 was near average in temperature, the number of days with snow on the ground and severity (Table 2). Total precipitation and snowfall were above average. The winter generally was characterized by alternate mild and cold periods, with periods of severe winter conditions persisting through April and May. The severity index for April-May, 1982 (Table 3) was considerably higher than average and second only to 1975 for the period 1971-1982. The maximum snow-depth in Bozeman recorded during April was as great as at any time during the winter, and half the days in the month had 1 inch or more snow on the ground.

Table 2. Climatological data, MSU Weather Station, Bozeman, and severity indices[1], 1971-1982, November through May.

	Avg. Temp. (OF)	Ppt. (In.)	Total Snowfall (In.)	Max. Snow Depth (In.)	No. Days Snow on Ground	Severity Index[1]
1971-72	33.9	7.7	81.8	10	119	-329
1972-73	31.3	8.4	92.6	14	135	+1335
1973-74	34.3	10.0	89.9	14	116	+2025
1974-75	30.5	12.1	118.6	17	161	+2286
1975-76	35.2	9.9	95.2	12	86	-810
1976-77	37.4	7.9	57.8	9	88	-2391
1977-78	33.9	10.0	60.5	12	111	+790
1978-79	29.9	10.7	87.4	18	159	+7843
1979-80	33.3	10.9	100.7	20	144	+752
1980-81	37.6	12.9	55.6	8	74	-2871
1981-82	32.8	11.5	125.3	11	129	+818
20 Year Mean	32.4	9.5	87.8[2]	13.18[2]	120[2]	+859[2]

[1]Follows Picton and Knight (1969). Positive values indicate greater severity.

[2]11-year mean.

Table 3. Spring severity at MSU Weather Station, 1972-82

	March	April	May	March-May	April-May
1972	-586	-652	-958	-732	-805
1973	-303	-520	-989	-604	-754
1974	-206	-764	-880	-617	-822
1975	295	-141	-803	-216	-472
1976	262	-663	-1157	-519	-910
1977	-184	-875	-946	-668	-910
1978	59	-692	-886	-506	-789
1979	-125	-623	-1269	-672	-946
1980	526	-738	-1046	-419	-891
1981	-535	-734	-895	-721	-814
1982	-226	-452	-857	-512	-654
Mean 1972-82	-93	-623	-971	-562	-797

Mean snow depths and percentages of ground covered by snow on winter ranges were somewhat greater during 1981-1982 than the prior two years, but much less than in 1978-1979 (Table 4). The duration of considerable snow cover was almost as long on west slope ranges as the extremely severe 1978-79 winter and much longer on east side winter ranges. As in previous years, the Blacktail Mtn. winter range consistently experienced the greatest snow depth and coverage and the Livingston winter range the least. This was due at least partially to the 230 meter elevation difference between the two winter ranges.

Wind speeds at most of the weather stations were the highest recorded since 1978-79, but they were only slightly higher than in 1978-79 (Table 5). There appears to be a direct relationship between average winter wind speed and severity. This seems reasonable because comparatively severe winters are associated with frequent passage of low pressure systems which normally are accompanied by winds, pull cold air from the north or northwest and draw moisture for snow from the west.

Table 4. Snow coverage and depths compared for four mule deer winter ranges in the Bridger Mountains, 1978-1981. Depths compared with Bozeman Weather Stations.

	Armstrong	Blacktail Mountain	Brackett Creek		Livingston
			Leffingwell	Peckenpaugh	
	Percent of measuring dates with snow on ground				
1978-79[1]	73	100	67	ND	40
1979-80[3]	73	73	70	79	48
1980-81[3]	52	52	52	42	39
1981-82[3]	72	79	76	76	59
	Mean percent snow coverage per measurement				
1978-79[1]	78	85	76	ND	63
1979-80[3]	54	59	52	58	29
1980-81[3]	34	45	36	31	29
1981-82[3]	65	70	62	62	48
	Bozeman	Mean snow depth per measurement			
1978-79[2]	2.21[4]	1.93	2.76	2.21	ND	.55
1979-80[3]	1.15[4]	.83	1.26	.82	.72	.31
1980-81[3]	.27[4]	.38	.56	.22	.16	.17
1981-82[3]	.95[5]	.95[5]	.92	1.40	.68	.42

[1] Nov. 9-Apr. 13

[2] Dec. 28-Apr. 13

[3] Entire snow period

[4] Bozeman 6W weather station

[5] Bozeman MSU weather station

Table 5. Mean winter/spring wind speeds (miles/hour) on five mule deer winter ranges in the Bridger Mountains, 1978-1982.

	Schafer Creek	Armstrong	Blacktail Mountain	Brackett Creek		Livingston
				Leffingwell	Peckenpaugh	
1978-79	1.63	2.54	2.66	4.60	6.39	6.68
1979-80	1.04	2.40	2.58	4.23	5.66	6.36
1980-81	Disc.[1]	2.42	2.65	3.95	4.77	5.79
1981-82	-	2.59[2]	2.75[2]	4.67[2]	6.28[3]	6.75[4]

[1]Weather station dismantled

[2]Based on 182 days

[3]Based on 140 days

[4]Based on 167 days

Growth and phenological development of plants on the winter ranges was retarded in 1982 as compared to the preceding four years. Development and occurrence of specific phenological events for five selected species on the Armstrong winter range was also the latest in 1982 (Table 6). Dates of occurrence of specific phenological events ranged from 7 to 17 days later than the four-year average and ranged from 13 to 35 days later than in the earliest year, 1981.

Analysis of the relationship between spring severity and phenological development (Tables 3 and 6) indicated: 1) timing of the beginning of growth and phasic development of plants in the area is primarily dependent on melting of the winter/spring snowpack and secondarily dependent on temperature; 2)rates of development after melting of the snowpack are temperature dependent and not photoperiodic; 3) conditions in March are important for the timing and initiation of growth and development only if they are unusually cold. [Neither an average or severe March provides conditions suitable for the initiation of growth and development of vegetation in this area. Only during a milder than average March does the snowpack melt soon enough and temperatures become warm enough to allow growth to begin much before the end of the month. The timing of mid to late spring phenological events is not influenced by conditions in March. The timing of extremely early spring phenological events is influenced mostly by melting of winter/spring snowpack]; and 4) if March is not unusually mild, the severity of conditions during April is the main determinant of early to mid spring phenology [for lilacs in Bozeman, April severity has the greatest effect on timing of flower bud formation; April and May severity appear equal in determining timing of peak bloom].

Table 6, Phenology of selected plant species on the Armstrong winter range, 1979-82 and lilacs in Bozeman, 1972-1982. Number of days event occurred after March 15.

	RAGL[1] 1st bloom	BASA 1st bloom	AGSP 4" height	DEBI 1st bloom	CEAR 1st bloom
1979	14	57	41	50	47
1980	36	41	34	41	48
1981	5	39	34	39	39
1982	39	60	52	52	67
Mean	23	49	40	45	50

[1]RAGL - buttercup, BASA - balsamroot, AGSP - bluebunch wheatgrass, DEBI - larkspur, CEAR - chickweed

Vegetation Production on Summer Range in the Armstrong Area

Production of understory vegetation was estimated in 1980 and 1981 for nine macroplots using a homemade capacitance meter to: 1) determine year to year variation in forage production on summer range in the Bridger Mountains as compared with the Missouri River Breaks; 2) generally relate understory production to major cover types and forest tree canopy coverage; and, 3) test the suitability of using electronic capacitance meters to estimate variations in forest understory forage production

On 6 of the 9 macroplots, the estimates indicated significantly ($P < .05$) or near significant ($P < .1$) less herbage production for 1981 contrasted to 1980; the other 3 macroplots were not significantly different at any level (Figure 2). However, even where significant, the differences in herbage production were slight and contrary to what might be expected based on precipitation data (Table 7). This may have been influenced by a severe hailstorm that passed through the area shortly before measurements were made in 1981 and heavily damaged much vegetation, even that occurring beneath fairly dense timber. Also, June 1981 was characterized by a period of cold snowy weather and a hard frost occurred in July.

Table 7. Precipitation at the MSU Weather Station, Bozeman, 1980-1981.

	Nov.-July [a]	Apr.-July	May-July	June-July
1980	14.87	9.49	9.1	3.97
1981	18	14.08	12.09	5.1

[a] November 1979-July 1980 and November 1980 through July 1981

Due to an inverse relationship between understory production and tree canopy coverage, the macroplots were arranged in Figure 2 from lowest to highest crown closure. The strong influence of degree of crown closure on understory production apparently overrode the effects of other factors (elevation, slope declivity, aspect, and species composition) on production. Aspect and tree species composition, as well as successional status, influence tree canopy coverage. This is illustrated by the weak to moderate correlation between these factors and production. The highest understory production was found on south and west-facing slopes where the lowest crown closure occurred. The lowest production tended to occur where crown closure was highest on lodgepole pine dominated, north facing slopes.

Distribution, Movements and Habitat Use

Winter

Aerial surveys during 1981-82 indicated that most deer population segments were restricted to their respective winter ranges by mid-late December. Animals associated with east-slope winter ranges began to disperse in early May; those on west slope ranges in early June.

Summer

Summer movement and distribution patterns of the Northwest slope, Southwest Slope, Brackett Creek, and Battle Ridge population units were similar to other years. Summer distribution pattern on the Blacktail, South 16-Mile, and Livingston population units will be defined during summer-fall 1982.

Population Characteristics

Trend and Dynamics of the Armstrong Deer Population

Trends in mule deer numbers and sex-age composition of the spring population on the Armstrong winter range from 1973-1981 were discussed in previous reports (Mackie et al. 1978, 1979, 1980, Pac et al 1981). Population estimates for mule deer using the Armstrong winter range during spring 1982 are presented in Tables 8 and 9. Cumulative ground observations, aerial observations, and trapping records provided data on numbers of marked deer on the area throughout winter and early spring. In early May, approximately 113 deer wearing recognizable collars used the area between Tom Reese Creek and North Cottonwood Creek. Of those, 76 ranged between Bill Smith and North Cottonwood Creeks.

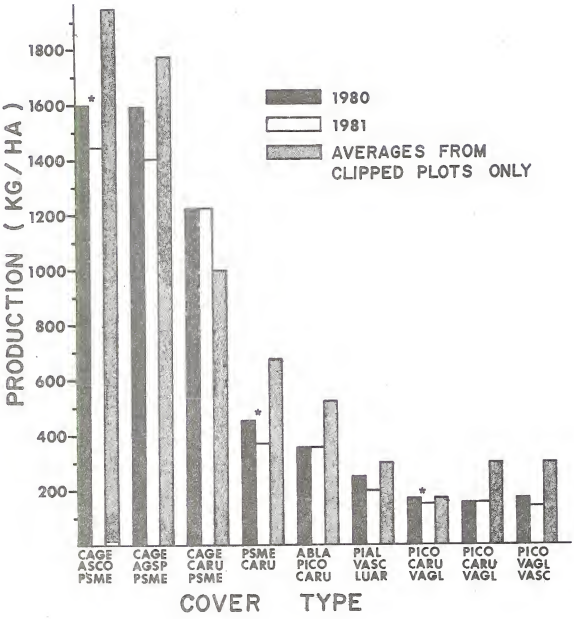


Figure 2. Understory production at 9 sites on summer range on the Armstrong study area, Bridger Mountains, 1980 and 1981. Sites arranged in order of increasing forest crown closure.

* Significant difference at P<.05

CAGE = Carex geyeri
PSME = Pseudotsuga menqiessi
CARU = Calamagnostis rubescens
PICO = Pinus contorta
VASC = vaccinium scoparium
VAGL = vaccinium globulare

ASCO = aster consipicuus
AGSP = Agropyron spicatum
ABLA = albies lasiocarpa
PIAL = pinus albicaulis
LUAR = lupinus argenteus

Even more marked animals could have been present since the fate of 1 fawn marked in 1982 was undetermined and 11 adults of unknown status were last seen in spring 1981. The mean percentage of collared deer in April-early May observations between Bill Smith and North Cottonwood Creeks was 45%.

Table 8. Spring estimates of numbers of mule deer on the Armstrong winter range, April, 1982.

Estimated Numbers		Remarks
Total	S	
170	19.46	$\bar{X}$ Lincoln Index for 15 ground surveys (52-129 deer obs./survey) and 76-77 collars in population.
171		Schnabel Index for 15 ground surveys (52-129 deer obs./survey) and 76-77 collars in population.

Table 9. Estimated late winter-spring mule deer populations on the Armstrong winter range, 1973-82.

			No. Males		
Year	Total No.	No. Adult Females	Adult	Yearling	No. Fawns
1973	230	123	31	27	49
1974	220	130	27	23	40
1975	140	92	35	8	5
1976	170	118	37	3	12
1977	200	120	24	6	50
1978	160	116	6	6	32
1979	140	104	6	11	19
1980	160	95	14	7	44
1981	170	98	13	6	53
1982	170	102	12	20	36

The best estimate of mule deer numbers on the Armstrong winter range was 170 during spring 1982. The mean Lincoln index for 15 ground surveys in April-early May was 170 mule deer. The Schnabel index was similar at 171 deer. The current estimate is the same as the population estimate for spring 1981.

Estimates of mule deer numbers on the Armstrong range during early winter (Figure 3) were reconstructed from the spring population using overwinter mortality rates of marked adults, and fawn: female and male: female ratios observed during classification flights in late December. The early winter population of 220 deer included about 117 females, 15 adult males, 23 yearling males, and 65 fawns. Using the Lincoln Index, a second, independent population estimate of 221 deer was computed for the Armstrong study area from the 27 December 1982 complete coverage helicopter survey.

The estimated 170 deer on the Armstrong range in spring 1982 included approximately 102 adult females, 12 adult males, 20 yearling males, and 36 fawns (Table 9). When compared with estimates for early winter, over-winter mortality was approximately 23 percent of the early winter population. It also represented approximately 13 percent of adult females, 16 percent of adult males, and 45 percent of the fawns. Known deaths included 6 adult females, 2 unclassified adults, and 11 fawns in the area between Bill Smith and North Cottonwood Creeks. Two adult females, 2 adult males, and 8 fawns were known to have died on the area between Bill Smith and Tom Reese Creeks. Trap related mortalities were limited to a 9½ year old female and 2 female fawns. Hunting mortality of males appeared to be higher in 1981 than the previous year. Tag returns in 1980 indicated that a minimum of 5 (28%) of 18 marked males were killed. During the 1981 hunting season, 5 (42%) of 12 marked males were shot. This included one apparent crippling loss. However, one (8%) of the 12 marked males which left the winter range in May 1981 and presumed to be alive during fall was not observed during the winter. Fifty percent of the marked males were known to be alive at the close of the hunting season. Hunting was for males only, except for 650 either-sex permits issued for HD312 which includes the Bridger Range. After the 1981 hunting season, a special questionnaire was sent to all 650 either sex permit holders for HD312; 556 (86%) were returned. Harvest and hunting season projections made from the returned sample for all 650 permit holders indicated that about 468 (72%) of 650 permittees actually hunted deer in HD312. Hunters averaged 3.7 days afield. Of those that hunted, 55% were successful. Permit holders harvested an estimated 257 deer in 1981 consisting of 212 mule deer (119F , 81M, 12Fawns) and 45 white-tailed deer (30F, 12M, 3 Fawns).

Sex and Age Structure in Relation to Population Phenomena

Trends in sex and age structure of the Armstrong mule deer population during 1981 and 1982 (Figure 4) followed those discussed by Mackie et al. 1980. Females 8.5 years and older continued to comprise substantial percentages of the female segment during 1981 and 1982. The strong 1.5 year cohort in spring 1982 reflected high recruitment in spring 1981.

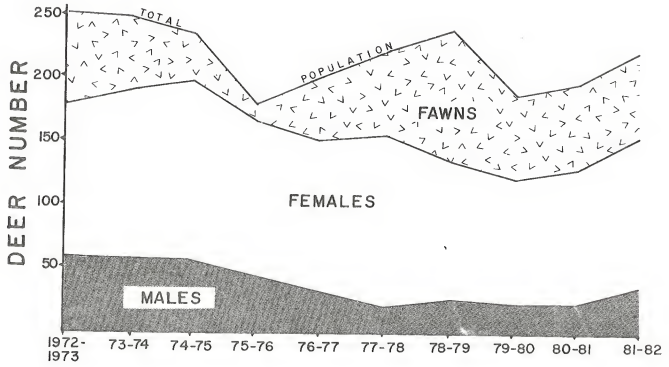
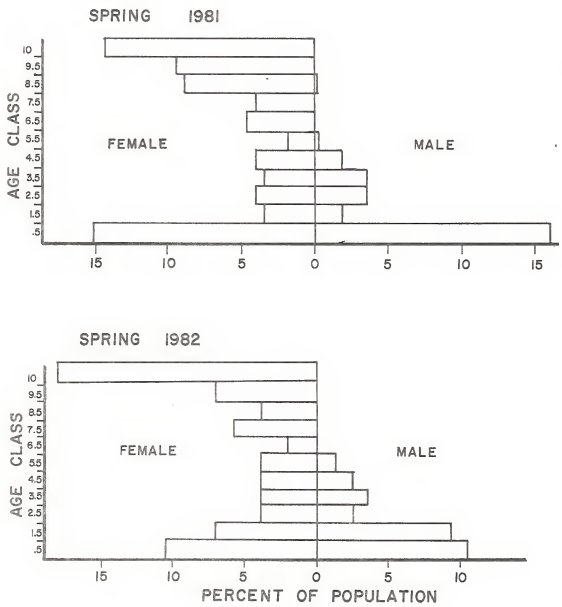


Figure 3. Early winter population trend of mule deer on the Armstrong winter range, Bridger Mountains, 1972-1982

Figure 4. Sex and age structure of the Armstrong mule deer population, Bridger Mountains, spring 1981 and 1982



Spring population sizes have remained stable during the 1981-82 period, because recruitment rates have equaled adult losses. It is unlikely that significant population increases will occur until adult female mortality rates decline. This can be expected after the 9.5 year and older female age classes move out of the population.

Fawn Production and Survival

Aerial classifications of mule deer on the Armstrong range during helicopter surveys in late December 1981 and late March 1982 are listed and compared with previous years in Table 10. The observed ratios (50 fawns: 100 females and 38 fawns: 100 adults in 1982) indicated moderate fawn survival to early winter. The late-March ratio of 46 fawns: 100 adults indicated that fawn survival to late winter was the second highest recorded since the study began in 1972. However, significant fawn mortality occurred after the March helicopter survey. Ground and aerial classifications in late April indicated a fawn:adult ratio of 28:100. An overwinter mortality rate of 45 percent was computed from a sample of 22 fawns trapped and marked in early winter. Most of the mortality occurred during late March and early April.

Table 10. Aerial classifications of mule deer on the Armstrong winter range, January 1972 through April 1982.

Reese Creek - N. Cottonwood	NUMBERS							RATIOS			PERCENTAGES		
	Total Count	Total Class.	Adults	Males	Females	Fawn	Uncl.	F:100 Females	F:100A	Males:100 Females	% Fawn	% Ylg. Males	% Spike Ylg. Male
1971-72 Jan. 3	173	173	119	39	80	54	-	68	45	49	31	56	26
Mar. 28	92	83	68	-	-	15	9	-	22	-	18	-	-
1972-73 Feb. 7	188	188	143	-	-	55	-	-	31	-	24	-	-
1973-74 Dec. 27	131	131	100	28	72	31	-	43	31	39	24	46	62
Apr. 1	188	188	154	-	-	34	-	-	22	-	18	-	-
1974-75 Jan. 5	140	140	116	37	79	24	-	30	21	47	17	19	17
Mar. 23	227	227	214	-	-	13	-	-	6	-	6	-	-
Apr. 20	99	99	96	-	-	3	-	-	3	-	3	-	-
1975-76 Jan. 2	121	121	113	29	84	8	-	10	7	35	7	7	100
Mar. 15	102	102	90	-	-	12	-	-	13	-	12	-	-
1976-77 Jan. 5-9	90	90	70	14	56	20	-	36	29	25	22	21	100
Mar. 10-11	116	116	87	-	-	29	-	-	33	-	25	-	-
1977-78 Dec. 19	133	133	94	11	83	39	-	47	42	13	29	46	40
Apr. 2	126	126	101	-	-	25	-	-	25	-	20	-	-
1978-79 Dec. 26	118	118	68	14	54	50	-	93	74	26	42	43	29
Mar. 12	98	98	68	-	-	30	-	-	44	-	31	-	-
1979-80 Jan. 9	132	132	85	16	69	47	-	68	55	23	36	37	50
Mar. 17	101	73	28	-	-	28	-	-	38	-	28	-	-
1980-81 Jan. 8	69	68	44	7	36	25	1	69	57	19	36	29	50
Mar. 19	129	129	83	-	-	46	-	-	55	-	36	-	-
1981-82 Dec. 27	131	131	95	23	72	36	-	50	38	32	28	61	43
Mar. 23	162	161	110	-	-	51	1	-	46	-	32	-	-
Apr. 29	137	137	107	-	-	30	-	-	28	-	22	-	-

Table 11. Numbers and sex and age ratios of mule deer classified by aerial (helicopter) survey on various winter ranges in the Bridger Mountain complex during early and late winter, 1971-72 through 1981-82.

		1971-72		1972-73		1973-74		1974-75		1975-76		1976-77		1977-78		1978-79		1979-80		1980-81		1981-82	
		Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late
NO. END	No. Classif.	204	352	523	-	367	356*	412	600	288	266	236	281	325	315	302	252	285	325	-	69	362	414	489
WEST SLOPE	dd:100 ♀♀	39.6	-	-	-	39.0	-	31.1	-	29.9	-	24.7	-	19.7	-	16.7	-	16.8	-	19.4	-	39.6	-
	FF:100 ♀♀	62.3	-	-	-	38.3	-	34.8	-	9.2	-	37.0	-	48.7	-	84.7	-	66.2	-	69.4	-	58.9	-
	FF:100 AD	44.6	29.9	32.7		27.4	19.0	26.5	9.4	7.1	6.1	29.6	34.4	40.7	30.3	72.5	39.9	55.7	46.4	56.8	63.1	42.2	46.1
SO. END	No. Classif.	470	332	271		174	162	459	448	335	307	335	365	336	121	277	473	325	504	-	571	-	566
WEST SLOPE	dd:100 ♀♀	39.1	-	-		39.6	-	22.8	-	20.6	-	27.2	-	25.0	-	11.2	-	20.4	-	-	-	-	-
	FF:100 ♀♀	45.4	-	-		32.6	-	51.1	-	25.8	-	46.1	-	53.7	-	61.2	-	61.4	-	-	-	-	-
	FF:100 AD	32.6	26.7	38.1		23.4	14.8	41.6	31.7	20.0	12.0	36.2	30.8	42.9	31.2	55.0	39.9	50.9	43.5	-	54.7	-	47.6
BLACKTAIL MOUNTAIN	No. Classif.	-	-	-		-	-	79	-	174	-	69	133	221	93	172	92	-	191	-	194	-	240
	dd:100 ♀♀	-	-	-		-	-	48.6	-	33.3	-	24.3	-	19.2	-	11.9	-	-	-	-	-	-	-
	FF:100 ♀♀	-	-	-		-	-	64.8	-	27.7	-	62.1	-	50.7	-	90.4	-	-	-	-	-	-	-
	FF:100 AD	-	-	-		-	-	43.6	-	20.8	-	50.0	37.1	42.5	40.9	80.8	27.8	-	59.1	-	59.0	-	42.9
NORTH 16-MILE	No. Classif.	-	-	-		-	-	370	-	290	-	307	-	543	-	601	728	-	725	-	881	-	988
	dd:100 ♀♀	-	-	-		-	-	6.2	-	16.2	-	5.0	-	7.5	-	14.0	-	-	-	-	-	-	-
	FF:100 ♀♀	-	-	-		-	-	24.5	-	22.4	-	49.2	-	68.2	-	67.7	-	-	-	-	-	-	-
	FF:100 AD	-	-	-		-	-	23.1	-	19.3	-	46.8	-	63.4	-	59.4	46.8	-	71.3	-	80.9	-	49.7
NORTH 16-MILE	No. Classif.	-	-	-		-	-	665	483+	766	725	814	831	910	1050	1267	1041	700	1204	-	-	-	-
	dd:100 ♀♀	-	-	-		-	-	6.6	-	15.9	-	8.0	-	9.5	-	14.9	-	16.8	-	-	-	-	-
	FF:100 ♀♀	-	-	-		-	-	35.4	-	25.6	-	43.3	-	67.8	-	77.5	-	88.8	-	-	-	-	-
	FF:100 AD	-	-	-		-	-	33.2	32.7	22.1	10.0	40.0	25.9	61.9	39.3	67.6	47.6	76.0	65.8	-	-	-	-
BATTLE RIDGE	No. Classif.	-	-	-		-	-	-	-	148	-	81	-	388	-	629	515	-	608	-	396	-	808
	dd:100 ♀♀	-	-	-		-	-	-	-	5.3	-	24.5	-	22.8	-	24.6	-	-	-	-	-	-	-
	FF:100 ♀♀	-	-	-		-	-	-	-	25.6	-	54.1	-	78.2	-	96.1	-	-	-	-	-	-	-
	FF:100 AD	-	-	-		-	-	-	-	24.3	-	47.2	-	63.7	-	77.1	42.7	-	65.7	-	94.1	-	61.0
BRACKETT CREEK	No. Classif.	-	-	-		-	-	299	-	560	-	-	-	978	509	1120	1057	579	1017	446	1212	1293	1707
	dd:100 ♀♀	-	-	-		-	-	11.3	-	5.0	-	-	-	12.2	-	13.1	-	7.5	-	11.3	-	12.7	-
	FF:100 ♀♀	-	-	-		-	-	49.4	-	32.5	-	-	-	74.1	-	77.2	-	81.7	-	91.3	-	79.4	-
	FF:100 AD	-	-	-		-	-	44.4	-	31.0	-	-	-	66.0	51.2	68.1	31.1	76.0	64.6	82.0	97.4	70.5	56.9
LIVINGSTON-BILLMAN CR.	No. Classif.	-	-	-		-	-	300	-	223	-	-	-	266	-	460	436	-	485	-	587	-	638
	dd:100 ♀♀	-	-	-		-	-	12.8	-	10.7	-	-	-	18.9	-	24.1	-	-	-	-	-	-	-
	FF:100 ♀♀	-	-	-		-	-	41.0	-	26.1	-	-	-	67.1	-	74.4	-	-	-	-	-	-	-
	FF:100 AD	-	-	-		-	-	36.3	-	23.6	-	-	-	56.4	-	57.6	28.2	-	63.9	-	95.7	-	36.3
OTHER MISCELLANEOUS AREAS	No. Classif.	-	-	-		-	-	-	-	-	-	-	-	28	-	26	-	-	22	-	-	-	-
	dd:100 ♀♀	-	-	-		-	-	-	-	-	-	-	-	7.1	-	11.1	-	-	-	-	-	-	-
	FF:100 ♀♀	-	-	-		-	-	-	-	-	-	-	-	92.9	-	100.0	-	-	-	-	-	-	-
	FF:100 AD	-	-	-		-	-	-	-	-	-	-	-	86.9	-	90.0	-	100.0	-	-	-	-	-
BRIDGER RANGE TOTALS	No. Classif.	674	648	794		541	518	2592	1531	2784	1298	1842	1610	4060	2088	4854	4594	1889	3681	515	4203	1767	5436
	dd:100 ♀♀	39.3	-	-		39.7	-	14.8	-	16.5	-	13.5	-	14.6	-	16.0	-	19.1	-	12.5	-	18.6	-
	FF:100 ♀♀	50.3	-	-		36.4	-	38.7	-	25.1	-	45.0	-	66.4	-	77.7	-	78.1	-	88.3	-	74.8	-
	FF:100 AD	36.1	28.3	34.4		26.1	18.5	33.7	22.3	21.5	9.7	39.6	29.3	58.0	39.9	66.9	43.9	67.9	62.1	78.2	81.3	62.9	51.4

*Not including 100+ unclassified
+Northwest of 16-Mile Creek only

Late spring population estimates show 40 fawns: 100 females in spring 1973, 31:100 in 1974, 5:100 1975, 10:100 in 1976, 42:100 in 1977, 27:100 in 1978, 18:100 in 1979, 46:100 in 1980, 54:100 in 1981, and 35:100 in 1982. Therefore, fawn survival to spring 1982 was moderate when compared to other years.

General Population Characteristics of Bridger Mountain Mule Deer 1981-1982

Totals of 1,707 and 5,436 mule deer were classified during the early and late winter helicopter surveys (Table 11). Only the Brackett Creek and Northwest Slope winter ranges were surveyed in early winter. The entire Bridger Range, excluding the North 16-Mile area, was flown in late winter.

Total counts in early winter on the Northwest Slope and Brackett Creek were higher in 1981-82 than all other years. Sampling efficiencies, estimated from marked animals, were approximately 45 and 48 percent for the Northwest Slope and Brackett Creek, respectively.

The total count for the entire Bridger Range in late winter 1981-82 was the highest recorded since the study began. Late winter sampling efficiencies on east slope winter ranges were 87% on Livingston, 83% on Brackett Creek, 77% on Battle Ridge and 70% on South 16-Mile. Sampling efficiencies on west slope winter ranges were 60% on the Southwest Slope and Northwest Slope, and 76% on Blacktail Mountain. Using these data, a total mule deer population of 5,240 was estimated for east slope ranges and 2,075 for west slope ranges. The total population of 7,315 for the entire Bridger Range was less than the 8,620 mule deer reported by Pac et al (1981) for late winter 1981. The current figure represents more refined population estimates particularly for Livingston, Blacktail Mt. and South 16-Mile because they were computed using marked samples that were not available in 1981. On all winter ranges, over-winter mortality apparently was much higher in 1982 than the previous years.

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STUDY NO. BG-1.0 JOB NO. 2

JOB TITLE: Population ecology and habitat relationships of mule deer in river breaks habitat in northcentral Montana.

ABSTRACT:

Mule deer fawn production and recruitment continued to decline since the peak in 1979, but was much higher than during the first three years of the study. Although dispersal by yearlings slowed the rate of increase, the population increased slightly over the level of 1980-81. A minimum of 34 adult female and 19 fawns were harvested on the study area during the first either/sex hunting season since 1974. These totals represent 4% and 6% of the pre-season population of adult female and fawns. Twenty-one percent of radio-collared fawns died during summer 1981. All of these deaths were attributed to coyote predation. White-tailed deer fawn production and population trend follows the same trend as observed for the adjacent mule deer population.

JOB OBJECTIVES:

1. To determine basic biological and ecological parameters of mule deer populations associated with timbered breaks habitat of central and eastern Montana;

2. To relate those basic population parameters to (a) characteristics of specific individual habitats or environments and (b) specific, potential limiting factors associated with individual populations and habitats, including nutrition, other wild ungulates, domestic livestock grazing and range management practices, coyote predation, weather, and hunting;

3. To further develop and test hypotheses relating to deer-habitat interactions and population regulation; and

4. To develop new methods, criteria, and guidelines for deer management, generally, and specifically, for timbered breaks habitats.

INTRODUCTION

In 1960, an intensive study of mule deer and their relationship to elk and domestic livestock was established on a representative 75,000 acre area in the Missouri River Breaks approximately 25 miles northeast of Roy, Montana. Habitat use and population studies were conducted from June 1960 through September 1963 and intermittently from October 1963 through May 1964 (Mackie 1970). From the summer of 1964 through spring 1975, less intensive studies were continued on the area primarily to obtain population data for mule deer (Mackie 1966, 1973 and 1976).

In July 1975, intensive studies resumed under the statewide deer research program to further evaluate factors regulating mule deer populations in the breaks type habitat of eastern Montana. Results through June 1981 were reported previously (Hamlin 1977, 1978, 1979, 1980, 1981) and Knowles 1976. In 1976, special studies were established to evaluate coyote-deer relationships. These included graduate thesis research projects investigating mortality of mule deer fawns during summer (Dood 1978, Riley 1982) and the distribution and abundance of small mammals (Trout 1978). They also included determination of coyote population characteristics and trends (Pyrah 1980, Schladweiler 1980). During the summer of 1976, a special study was also established to measure annual production of various grasses, forbs and browse species on various habitat types and to relate forage production to seasonal and annual weather conditions.

This report summarizes data collected during 1981-82 concerning deer population trends and characteristics and their relationship to environmental factors. Data on coyote population trends are summarized and discussed in Appendix A, while data on forage production and trends are presented and discussed in Appendix B.

STUDY AREA

The south study area encompasses all of the timbered "breaks" portion of the area described by Mackie (1970) as extending approximately 20 miles on a 4 to 7 mile wide belt adjacent to the Missouri River in Fergus County, Montana (Fig. 1). It comprises approximately 100 square miles between U.S. Highway 191 on the west, the Skyline Trail on the east, the Missouri River on the north and the Musselshell trail on the south. Physiography, climate, land use and vegetation of this area were described in detail by Mackie (1970). Some of the work described in this report was conducted on the adjacent Missouri River Bottomlands described by Allen (1968) and NE across the river on the Nichols Coulee Resource Conservation Area (north study area) described by Knowles (1975).

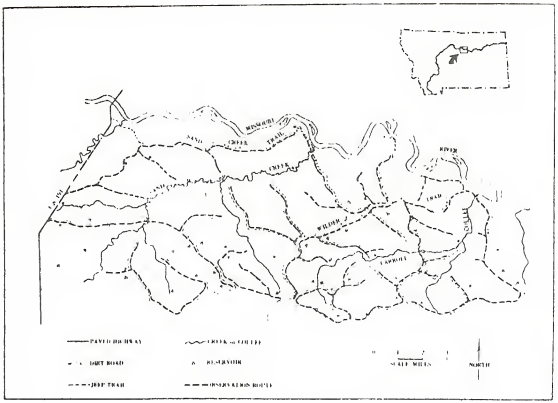

Figure 1. Map of the study area.

METHODS

Population data were obtained during fixed-wing surveys at various times of the year and helicopter surveys during December and March (Mackie, Hamlin and Pac 1980). Sex and age classifications and deer distribution and habitat use were obtained during all aerial surveys. Population estimates were made using data from helicopter surveys in most years. During the last 3 years, sufficient numbers of marked deer were present on the study area to permit use of the Lincoln Index (Overton and Davis 1969) for all aerial surveys. Supplementary information was obtained throughout the year from the ground during the course of normal activities.

Data on initial fawn production and subsequent fawn survival were obtained by aerial and ground reconnaissance. Survival was also measured by following radio-collared fawns. The river and reservoir ice was flown periodically during winter to check for coyote-killed deer. The uplands were checked for coyote-killed deer during aerial flights to relocate collared deer and during other normal activities. Carcasses are listed as probable coyote kills based on evidence of tracks in the snow, trails of blood on snow or vegetation and other site evidence.

Deer have been captured during winter in order to attach radio transmitters or observational collars. Methods have included the cannon net (Mackie et al. 1975), the Clover trap (Clover 1954), a helicopter drive net and darting from a helicopter. Newborn fawns are caught by the method described by Dood (1978).

Aerial relocations of radio-collared deer were obtained at 1-2 week intervals and relocations from the ground were made as time permitted.

Other techniques have been described in previous reports (Hamlin 1977, 1978, 1979, 1980).

RESULTS

Mule deer population trend

Fawn production and recruitment were much higher than during the first three years of the study (Tables 1 and 2). Recruitment continued to decline from the peak observed in 1979-80.

Tentative population estimates for 1981-82 (Fig. 2 Table 3) indicated that the population increased slightly from the previous year. These estimates are not final because the presence or absence of several marked deer has not been verified. As in 1980-81, the population increased at a slower rate than predicted on the basis of observed recruitment and fawn production (Table 3). This reflected the dispersal of 21% of radio-collared yearling females from the population during 1981. Also, 1981 was the first hunting season since 1974 in which the harvest of antlerless deer was allowed, resulting in a known harvest of 34 adult females and 19 fawns from the study area. The loss of 39 females through dispersal and 34 through hunting explain almost all the differences between 665 females predicted and 590 observed (Table 3). Both total population numbers and number of adult females are near the previous "highs" observed in 1960 and 1970 (Fig. 2). The preseason adult female population was about 4% below the previous estimated high of 650 in 1960.

White-tailed deer population trend

Data in Table 4 indicate that population trend and fawn production and recruitment of white-tailed deer on Missouri River bottomland has followed the same pattern as observed for mule deer in adjacent uplands. The factors affecting these populations may not be specific to species or habitat, but to a general influence across a geographical area.

Table 1. Sex and age composition of mule deer population on the Missouri Breaks Study Area, 1960-61 through 1981-82 Data were derived as aerial or ground classifications during December or early January of each year except 1969-70 and 1972-73, when classifications were completed during February and March, respectively.

Year	Type of Observation	Number Classified	Percentage			Ratios			% of Yrlg. Males	
			Males	Females	Fawns	Males: 100 FF	Fawns: 100 FF	Fawns: 100 AD	Obsv.	Harv.
1960-61	Ground[1]	668	9.3	48.6	42.1	19.1	86.4	72.6	56	46
1961-62	Ground	430	15.5	60.7	24.0	25.3	39.5	31.5	74	47
1962-63	Ground	190	19.5	52.1	28.4	37.5	54.5	39.7	63	34
1963-64	Aerial[2]	362	16.0	45.6	38.4	35.1	84.2	63.3	47	36
1964-65	Aerial	611	22.7	47.8	29.5	47.6	61.6	41.7	47	43
1965-66	Aerial	434	21.4	58.1	20.5	36.9	35.3	25.8	33	13
1966-67	Aerial	289	17.3	52.6	30.1	32.9	57.2	43.1	46	
1967-68	Aerial[3]	115	20.0	40.0	40.0	50.0	100.0	66.7	--	
1968-69	None	-	-	-	-	-	-	-	--	
1969-70	Aerial	110	-	-	39.1	-	-	64.2	--	
1970-71	Aerial	776	18.8	48.1	33.1	39.1	68.9	49.5	47	
1971-72	Aerial	679	19.0	53.8	27.2	26.1	50.6	37.4	46	
1972-73	Aerial	235	-	-	19.1	-	-	23.7	--	
1973-74	Aerial	370	24.1	49.5	26.5	48.6	53.6	36.0	43	
1974-75	Aerial	315	25.6	55.1	19.3	46.0	35.1	24.0	50	
1975-76	Aerial	323	15.5	57.6	26.9	26.9	46.8	36.9	28	
1976-77	Aerial	258	17.4	57.4	25.2	30.4	43.9	33.6	40	
1977-78	Aerial	322	10.9	58.7	30.4	18.5	51.9	43.8	48	
1978-79	Aerial	501	13.2	42.3	44.5	31.1	105.2	80.2	55	
1979-80	Aerial	675	11.3	41.0	47.7	27.4	116.2	91.2	54	
1980-81	Aerial	850	12.5	45.8	41.8	27.2	91.3	71.7	64	
1981-82	Aerial	1055	11.9	49.3	38.8	24.2	78.7	63.3	64	

[1]Cumulative observations on area during December.

[2]All [illegible]ial observations by helicopter except 1969-70 ([illegible]ed--wing aircraft).

[3]Only west half of area surveyed in 1967-68.

Table 2. Classifications and observed recruitment of fawns on the south side Missouri Breaks study area, 1975-76 through 1981-82.

Date	Numbers	Adults	Young	Females	Males	Uncl.	Fawns/ 100 Adults	Fawns/ 100 FF
Sept.-Oct. 1975	105	69	36	50	19	-	52	72
December 1975	323	236	87	186	50	-	37	47
March 1976	193	173	19	--	--	-	11	--
October 1976	159	110	49	79	31	-	45	62
December 1976	258	193	65	148	45	-	34	44
March 1977	293	225	68	--	--	-	30	--
October 1977	112	70	41	51	20	-	59	80
December 1977	322	224	98	189	35	-	44	52
March 1978	255	195	51	--	--	9	26	--
September 1978	176	102	74	69	33	-	73	107
December 1978	501	278	223	212	66	-	80	105
March 1979	409	248	161	--	--	-	65	--
October 1979	278	157	120	100	57	1	76	120
January 1980	680	353	322	277	76	5	91	116
March 1980	683	375	308	--	--	-	82	--
September 1980	548	355	190	216	139	3	54	88
January 1981	854	495	355	389	106	4	72	91
March 1981	747	458	280	--	--	9	61	--
September 1981	671	447	230	292	151	--	51	79
December 1981	1062	646	409	520	126	7	63	79
March 1982	869	570	299	--	--	--	53	--
April 1982	295	205	90	--	--	--	44	--

Figure 2.

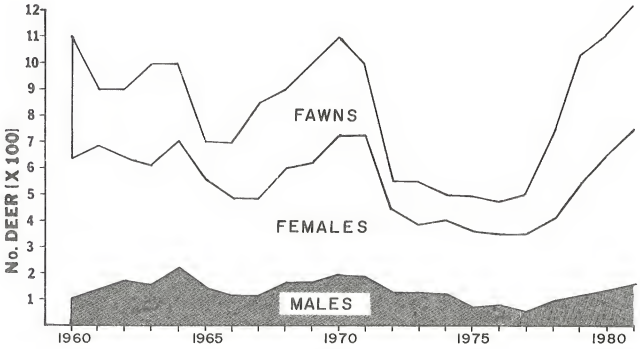
No. DEER (X 100)
12
11
10
9
8
7
6
5
4
3
2
1
FAWNS
FEMALES
MALES
1960
1965
1970
1975
1980

Table 3. Population estimates of mule deer on the south Missouri River Breaks study area.[1]

	Males	Females	Fawns	TOTAL
1977-78 Early Winter	55	295	150	500
Late Winter	50	280	85	415
	43	42		
Predicted E. Winter 1978-79	93	322		
1978-79 Early Winter	95	310	325	735
Late Winter	90	295	250	635
	125	125		
Predicted E. Winter 1979-80	215	420		
1979-80 Early Winter	115	410	475	1000
Late Winter	105	395	410	910
	205	205		
Predicted E. Winter 1980-81	310	600		
1980-81 Early Winter	135	505	460	1100
Late Winter	130	480	370	980
	185	185		
Predicted E. Winter 1981-82	315	665		
1981-82 Early Winter	140	590	470	1200
Late Winter	135	575	315	1025
	158	157		
	293	732		

[1]Early and late winter estimates are based on Lincoln Indexes, changes in sex and age ratios, and other indicators (Mackie et al 1980). Predicted levels do not take hunting loss, dispersal or other mortality occuring between June and December into account.

Table 4. White-tailed deer numbers and sex and age composition from early winter surveys, 1960-1982.

Year	Numbers					Ratios			
	Total	Adult	Young	Female	Male	YG:100 AD	YG:100 Females	Male:100 Females	% Yearling Males
1960-61[1]	28	18	10	-	-	55.5	-	-	-
1961-62[1]	120	54	66	-	-	122.2	-	-	-
1962-63[1]	106	76	30	-	-	39.5	-	-	-
1964-65[2]	188	168	20	123	45	11.9	16.3	36.6	36.8
1965-66[2]	178	137	41	110	27	29.9	37.3	24.5	15.0
1966-67[2]	223	162	61	121	41	37.6	50.4	33.9	25.6
1971-72[2]	267	182	60	139	43	33.0	43.2	30.1	-
1973-74[2]	207	168	39	146	22	23.2	26.7	15.1	40.9
1975-76[2]	121	105	16	76	29	15.2	21.0	38.2	27.6
1976-77[2]	18	15	3	10	5	20.0	30.0	50.0	66.7
1977-78[2]	110	96	14	58	38	14.6	24.1	65.5	44.7
1978-79[2]	90	69	21	53	16	30.4	39.6	30.2	43.8
1979-80[3]	141	75	66	66	9	88.0	100.0	13.6	22.2
1980-81[4]	160	116	44	77	39	37.9	57.1	50.6	64.9
1981-82[4]	183	138	45	92	46	32.6	48.9	50.0	54.3

[1]Ground sample classifications.
[2]Helicopter surveys.
[3]Super Cub survey - 1-16-80, some males had probably lost their antlers, so both yg:100 female and male:100 female ratios would be somewhat higher than shown in the Table.
[4]Super Cub survey.

Production and mortality

Initial fawn production in mule deer (Table 5), while lower than the observed peak in 1979, was excellent. The mule deer population was not considered to be under nutritional stress since initial fawn production was excellent throughout the study years. Fawn recruitment, while lower than during 1979-80 and 1980-81, was considerably higher than that observed during 1975-78 (Table 2).

Twenty-one percent of the radio-collared fawns died during summer 1981 (Table 6). All of these deaths were attributed to coyote predation. Ninety-two fawns have been monitored during summer since 1976. Ninety percent of the twenty deaths which occurred were attributed to coyote predation (Table 6). All fawns appeared to be in excellent health at the time of their deaths. Summer mortality was lowest during the years when high vole populations occurred (1978 and 1979) and the year immediately following high vole populations. One radio-collared fawn died during fall 1981. Death was attributed to coyote predation. Probable coyote-killed deer found during winter are listed in Table 7. The number of coyote-killed deer increased somewhat from that observed during 1977-80, but remained below levels observed in 1975-76 and 1976-77.

The known hunting mortality of 69 adult males was the same as observed during 1980. Known minimum hunting mortality of 34 adult females and 19 fawns represented less than 6% and less than 4%, respectively, of preseason numbers. A harvest of 130 adult females or 20.8% of the preseason adult female population would have maintained a stable female population. These figures do not include the 39 females that dispersed. Harvest could have been higher than 130 adult females if an attempt was made to shortstop the next year's dispersal.

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Submitted by: Kenneth L. Hamlin

Table 5 . Estimated mule deer fawn/female ratios in June and mid-July 1976-1981 on the south study area.

	Fawns/100 Producing Females		Percent Females Producing		Estimated Population Fawn/Doe ratio
June 1976	150:100(14)[1]	x	94[2]	=	141:100
July 1976	131:100(16)	x	71[3]	=	94:100
June 1977	152:100(27)	x	82[3]	=	125:100
July 1977	140:100(20)	x	76[3]	=	106:100
June 1978	165:100(26)	x	90[3]	=	148:100
July 1978	142:100(31)	x	83[3]	=	118:100
June 1979	176:100(37)	x	70[2]	=	123:100
July 1979	168:100(37)	x	70[2]	=	118:100
June 1980	168:100(22)	x	75[2]	=	126:100
July 1980	157:100(63)	x	75[2]	=	118:100
June 1981	162:100(26)	x	78[2]	=	126:100
July 1981	141:100(59)	x	78[2]	=	110:100

[1]Female Sample size in parenthesis.
[2]Percent of female population older than yearling.
[3]Percent of females observed alone or with fawns.

Table 6. Summer mortality and causes for marked mule deer fawns 1976-1981

Year	No. Fawns Monitored	No. Died	% Mort.	No. Definite Or Probable Coyote Killed	No. Unknown	No. Accident	% Coyote Killed
1976[1]	11	4	36	4	-	-	100
1977[1]	18	6	33	5	-	1	83
1978[2]	12	2	17	1	1	-	50
1979[2]	17	2	12	2	-	-	100
1980[2]	15	2	13	2	-	-	100
1981	19	4	21	4	-	-	100
Total	92	20	22	18	1	1	90

[1]Data from Dood (1978) and personal communication.
[2]Data from S. Riley (pers. comm.).

Table 7. Probable coyote-killed deer found during winter (December-March).

	Uplands	Bottomlands	River Ice	Reservoir Ice	TOTAL
Mule Deer					
1975-76	9	2	1	33	45
1976-77	4	0	3	9	16
1977-78	5	0	2	1	8
1978-79	3	0	1	1	5
1979-80	0	0	2	5	7
1980-81	2	0	5	2	9
1981-82	10	1	1	1	13
White-tailed Deer					
1975-76	1	10	9	0	20
1976-77	0	1	3	0	4
1977-78	0	1	0	0	1
1978-79	0	1	1	0	2
1979-80	0	0	1	0	1
1980-81	0	0	2	0	2
1981-82	0	0	1	0	1

APPENDIX A

Coyote Population Characteristics and Trends in the Missouri River Breaks, 1981.

by

Duane B. Pyrah

INTRODUCTION

This report presents the results of 1981 surveys and telemetry observations; it updates population characteristics and trends and movements of radioed den coyotes. Data were collected only in the South Missouri Breaks; surveys were discontinued in the North Missouri Breaks. Surveys consisted of siren responses and den area estimates (Pyrah 1980) in the Missouri River breaks (Mackie 1970). Relocation of the three 1979 radioed coyotes continued.

RESULTS

The 1981 coyote population estimate (97) remained near the 1978-80 average (96), or a density of 0.39/km^2 (1/mi^2), (Table 1). Siren responses revealed 0.25 coyotes/km^2 (0.65/mi^2), 65% of the estimated density. The siren surveys indicated a higher per station response average for the Musselshell-Skyline (5.36) than the Wilder-Sand Creek (4.28), (Table 2). New litter locations indicated additional den areas for the Musselshell-Skyline route and absence of litter observations and multiple responses indicated some nonproducing den areas for the Wilder-Sand Creek route.

Table 1. Combined (siren, den area) survey for coyotes in the Missouri River breaks deer study area, 1977-81.

Den	1977			1978			1979			1980			1981		
Area	SA[1]	DAE[1]	HC[1]	SA	DAE	HC	SA	DAE	HC	SA	DAE	HC	SA	DAE	HC
A	4	6.2	6.2	1	.	1	4	5.2	5.2	4	3	3	0	3	3
B	3	6.2	6.2	1	5.8	5.8	4	5.2	5.2	5	4.8	5	1	4.9	4.9
C		5.2	5.2	5	5.8	5.8	4	6	6	3	4.8	4.8	0	2	2
D	1		1		5.8	5.8	6	5	6	5	4.8	5	3	4	4
E	8	5.2	8	5	5.8	5.8	5	7	7	7	4.8	7	6	5	6
F	2		2	1		1	6	6	6	4	4.8	4.8	6	9	9
G	6	9.2	9.2	6	7	7	6	5.2	6	5	5	5	7	4.9	7
H				4	6	6	5	6.2	6.2	4	3	4	6	5.9	6
I	1	7	7	8	5.8	8	6	5	6	7	4.8	7	5	7	7
J		6	6		5.8	5.8	7	8	8	3	3	3	4	4.9	4.9
K	2		2	8	5.8	8	2	5.2	5.2	3	6	6	4	4.9	4.9
L				2		2		6	6	4	4.8	4.8	3	4	4
M	6	5.2	6	1	8	8	4	5.2	5.2	6	4.8	6	1	3	3
N	1		1	1	6	6		3	3	2	0	2	3	4.9	4.9
O		5.2	5.2		5.8	5.8		6	6	3	4.8	4.8	5	4	5
P	1	5	5	1	6	6	3	5	5	2	8	8	6	5	6
Q		7	7	2	5	5		3	3	0	0	0	2	2	2
R		6	6	5	5	5		5.2	5.2	0	6	6	0	6	6
S	4	6.2	6.2		5	5	5	5.2	5.2	1	0	1	1	1	1
K1													6	6	6
Total	39	79.6	89.2	51	94.4	102.8	67	102.6	105.4	68	77.2	87.2	69	91.4	96.6

[1] SA = Siren Answers; DAE = Den Area Estimates; HC = High Count.

Table 2. Summary of siren survey coyote responses for high counts at each station, south study area, Missouri River breaks, 1976-81.

Study Area/Route	Year	Number of Coyotes	Number of Stations	Average Coyotes Per Station	Density of Coyotes[1/]
Wilder-Sand Cr.	1976	56	11	5.09	0.28
	1977	51	12	4.25	0.23
	1978	35	12	2.92	0.16
	1979	56	12	4.67	0.25
	1980	62	13	4.77	0.26
	1981	52	13	4.00	0.22
	Avg.	52	12	4.28	0.23
Musselshell-Skyline	1976	50	10	5.00	0.27
	1977	33	10	3.30	0.18
	1978	40	11	3.64	0.20
	1979	28	11	2.55	0.14
	1980	46	11	4.18	0.23
	1981	59	11	5.36	0.29
	Avg.	43	11	4.00	0.22
Totals	1976	106	21	5.05	0.27
	1977	84	22	3.82	0.21
	1978	75	23	3.26	0.18
	1979	88	23	3.83	0.20
	1980	108	24	4.50	0.25
	1981	111	24	4.62	0.25
	Avg.	95	23	4.18	0.23

[1/] Coyotes/km^2

Eleven litters were observed during 1981, compared to 6 litters observed in 1980 (Table 3). This difference probably resulted from earlier whelping and movement to litter rendezvous sites during 1980. Average litter size was 2.8 in 1980 and 2.9 in 1981. For 6 years of observations, 47 litters averaged 3.3 young.

Table 3. Yearly frequency distribution of observed coyote litters in the Missouri River breaks, 1976-81.

Litter Size	1976	1977	1978	1979	1980	1981	Total
1				2	2	2	6
2			2	1		4	7
3	3	4	1	3	1	1	13
4	1	1	3	4	3	2	14
5	1		1			1	3
6			1	1		1	3
7	1						1
Total litters	6	5	8	11	6	11	47
Total young	25	16	30	35	17	32	155
Average litter	4.2	3.2	3.8	3.2	2.8	2.9	3.3

Siren responses for den areas with multiple (3+) responses were compared with counts at observed litters (2 adults were assumed because both were not always observed)(Table 4). The number observed was slightly higher; however, these averages indicate close similarity by both methods for estimating family size.

Three of four 1979 radios continue to transmit. These radioed coyotes have remained in the same den area for 4 denning seasons. Four other coyotes remained in the same den area for 2 seasons. Because their transmitters failed, they may have remained longer but were not observed.

Coyotes in prairie habitat continue at lower density than those in breaks habitat (Table 5).

Table 4. Comparison between average number of coyote responses in multiple response (more than 3) den areas and average number of coyotes in den areas where litters were observed, Missouri River breaks, 1977-81.

	1977	1978	1979	1980	1981	Total or Average
Siren:						
Number	6	7	13	14	13	53
Responses	31	41	65	65	64	266
Average	5.2	5.9	5.0	4.6	4.9	5.1
Observed:						
Litters	5	8	11	6	11	41
Coyotes	28	45	60	31	55	219
Average	5.6	5.6	5.4	5.2	5.0	5.4

Table 5. Comparison of coyote density and population trend between breaks and prairie habitats by siren responses assigned to den areas, Missouri River breaks, 1976-81.

	Breaks (263 km^2)		Prairie (172 km^2)	
Year	No.	Density ($/km^2$)[1/]	No.	Density ($/km^2$)[1/]
1976	57	0.22	35	0.20
1977	39	0.15	21	0.12
1978	51	0.19	23	0.13
1979	67	0.25	12	0.07
1980	68	0.26	32	0.19
1981	69	0.26	30	0.17
Avg.	58	0.22*	26	0.15*

[1/] Density of responding coyotes, not corrected for estimates of non-responders.

*Difference significant at $P < 0.05$ ($t = 2.769$, 4 df).

DISCUSSION

Coyote density in the breaks has been stable since the 1978-79 vole irruption. Presumably the food base shifted from voles to cottontails (Sylvilagus nuttallii) which, by cursory observation, are abundant in breaks habitat. Cottontails appear to be less abundant in prairie habitat, except along drainages with riparian vegetation. An increase in whitetailed jackrabbits (Lepus townsendii) in 1981 (Hamlin pers. comm.) may cause an increase in prairie coyotes during ensuing years. An anticipated reduction of cottontails in breaks habitat may trigger higher coyote predation on deer; whereas, prairie coyotes may have an inclining jackrabbit cycle for a major prey base.

A program of coyote control could determine the effect of coyotes on deer populations. It still is not known what response the deer population would make in the absence of predation. It could also make deer, which are consumed as prey or carrion, available to study physiological parameters.

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APPENDIX B

Forage Production and Trends in the Missouri River Breaks, 1981

by

Henry E. Jorgensen

INTRODUCTION

This study of production of grasses, forbs and browse on selected habitat types within the Missouri River Breaks study area was established in 1976 to evaluate the response of various forage classes and species to weather conditions, the ultimate goal being to learn how to predict forage production from weather data. Through June 1980, the study was conducted within the framework of statewide habitat studies to evaluate existing range survey methods, concepts and criteria and develop practical methods of monitoring condition trends on big game ranges. During 1980, the study was included as part of investigations of population ecology and habitat relationships of mule deer in the Missouri River Breaks. In 1981 it was discovered from concurrent shrub ring width studies that widths of certain shrub annual growth rings were highly correlated with certain parameters of forage production. This report presents results of clipping studies during the summer of 1981 in relation to those of previous years and some results of analysis of weather-shrub annual ring-forage production relationships.

Procedures for the clipping study followed those described by Jorgensen and Mackie (1978). Porcedures for the annual growth ring study were as follows. A varying number, usually four to ten, cross sections of each of the major shrub species was collected each year from plants near the production sampling sites. Collections were made from 1977 through 1981. Annual growth rings were measured to .01 mm along at least two radii on each cross section.

RESULTS

The production of grass, of all the categories of vegetation sampled in this study,was the most similar between macroplots (sample sites) and appeared to be most consistently related to variations in moisture conditions between years. Grass production in 1981 was higher than in most years except 1978 (Table 1). Production of forbs was significantly higher in 1981 than any other year except 1978 to which it was essentially identical. Weather conditions in 1981 apparently were more favorable for forb than grass production.

In 1981, production of Comandra was significantly less than in 1977 on site 1 and less than 1978 and 1979 on site 2. Production varied more strongly and was consistently higher on site 2 than site 1, but production on neither site appeared related to weather conditions.

Dry matter production of sagebrush flower leaders was highest in 1981 and was closely synchronized with that of forbs implying a strong similarity in response to weather conditions. Measuring sagebrush flower leader production may provide a quicker means of estimating forb production on sagebrush grassland sites than clipping the forbs directly.

Yellow sweetclover production in 1981 was low at both sampling sites compared to years of high production but varied most from the year of greatest production on site 1. On stand 2, 1981 production was probably significantly less than 1978 and significantly more than 1977 and 1980. Data were too variable to detect significant differences in production between 1981, 1979, and 1976. Sweetclover production on site 1 was closely correlated with July through September precipitation of the preceding year at the Roy 8NE weather station (Table 2). On the basis of data from the six years of study, the square root of production can be expected to fall within 3.64 on either side of the values on the regression line 95 percent of the time. This indicates that at least some of the annual variation in sweetclover production is a result of precipitation during late summer of the year before. However, if precipitation is very high during the preceding late summer, but is extremely low both before and after that period, sweetclover production will not be as high as predicted.

Table 1. Current annual production on two sites in the sagebrush, bluebunch wheatgrass habitat type, Missouri Breaks, 1976-1980.

Stand 1

Species[1]	1976	1977	1978	1979	1980	1981
COUM	85[2]ab	101a[3]	87ab	87ab	56ab	30b
MEOF	15	≈0	72	464	0.62	2.6
FORBS	16ab	10ab	72a	8b	12b	72a
GRASS	291bc	236c	550a	288bc	178c	392b
ARTR[4]	8b	30b	ND[5]	3b	30b	96a

Stand 2

Species[1]	1976	1977	1978	1979	1980	1981
COUM	162abc	135abc	197d	182cd	139bcd	104a
MEOF	0.3	≈0	11	0.4	≈0	1.5
FORBS	15b	4b	116a	10b	14b	136a
GRASS	461b	272c	1030a	437b	251c	526b
ARTR[4]	11b	8b	ND	5b	13b	63a

[1]Species abbreviations: COUM: *Comandra umbellata* (bastard toadflax)
MEOF: *Melilotus officinale* (yellow sweetclover)
ARTR: *Artemisia tridentata* (big sagebrush)

[2]Kilograms per hectare.

[3]Letters denote significant or nonsignificant differences between years. The same letter for any of the years means that the differences were not significant and vice versa.

[4]Flower leaders only.

[5]No data collected.

Table 2. Correlation Coefficients[1] and Standard Errors[2] of Production Estimators vs. Production Estimates, Missouri Breaks, Montana, 1976-1981.

	Site 1		Site 2		Site 3	
	R^2	SE	R^2	SE	R^2	SE
ARTR flower leader production vs. Forb production.	.96*	5.4	.99*	5.6		
ARTR ring widths vs. grass production.	.82*	56				
RHTR ring widths vs. RHTR mean leader weight					.85*	15
RONU ring width vs. RONU mean leader weights					.885*	30
ARTR ring width vs. forb production	.81*	13.7				
MEOF production vs. July-Sept. ppt of preceding year at Roy 24NE	.76*	90				
MEOF production vs. July-Sept. ppt. of preceding year at Roy 8NE	.88*	78				
Square root of MEOF production vs. July-Sept. ppt. of preceding year at Roy 8NE	.95*	1.82				

[1] R^2

[2] SE

[3] Five years of data

* *Correlation coefficient is significant at P<.01*

Correlations between annual growth rings of some shrubs and production of some vegetation categories for the past six years have become apparent. Shrubs for which annual rings measurement appears to have the greatest value for predicting various forage production parameters are sagebrush, rose, and skunkbush sumac. Rings of chokecherry may also have the potential for predicting production, but the number of samples collected to date is not sufficient to establish this relationship. Highest correlations were found between sagebrush ring widths and grass production, sagebrush ring widths and forb production, skunkbush sumac ring widths and skinkbush sumac mean leader weights, and rose ring widths and rose mean leader weights (Table 2).

Table 3. Current annual production of shrubs in the Douglas fir/ chokecherry habitat type, 1976-1980.

Stand 3[1]

Species	1976	1977	1978	1979	1980	1981
RONU[4]	38[5]	17	223	87	7	49
SYOC	28	8	36	52	25	19
PRVI	ND	13	24	88	17	19
RHTR	39	27	136	204	37	86
RISE	-	-	-	-	-	-

Stand 4[2]

Species	1976	1977
RONU[4]	29	51
SYOC	42	64
PRVI	ND	40
RHTR	-	-
RISE	1	2

Stand 5[3]

Species	1976	1977	1978	1979	1980	1981
RONU[4]	30	11	42	23	13	12
SYOC	11	10	20	13	10	30
PRVI	ND	32	46	65	25	35
RHTR	1	16	16	34	8	6
RISE	-	-	-	-	-	-

[1] East of Haines Ridge.

[2] Near Phillips Coulee: discontinued after 1977.

[3] West end of Sand Creek Trail.

[4] RONU: *Rosa nutkana* (rose), SYOC: *Symphoricarpos occidentalis* (snowberry), RISE: *Ribes setosum* (gooseberry), PRVI: *Prunus virginiana* (chokecherry), RHTR: *Rhus trilobata* (skunkbush sumac).

[5] Kilograms per hectare.

The correlation between widths of annual growth rings and various forage production parameters offer potential for greatly simplifying estimates of forage production trends by eliminating the need for extensive clipping or leader measurements. Measurements of annual growth rings may also provide opportunity to estimate past forage production. As long as enough cross sections are collected over a wide enough area within a climatic zone, localized factors affecting ring width such as insect damage, site differences, animal disturbance, and fire average out and become less important than climatic factors.

Shrub dry matter production in 1981 as determined from leader length measurements (Table 3) was generally mediocre compared to preceding years. In all cases, except snowberry on site 5, estimated production was less than 1978 and 1979. On site 3, 1981 production of all sampled shrubs was higher than in 1977 and considerably higher than 1980 for rose and skunkbush sumac. Other differences on site 3 appeared inconsistent and are probably not significant. On site 5, differences between 1976, 1977, 1980, and 1981 were inconsistent. Even in 1978 and 1979, very productive years for most species, productivity of snowberry was not especially high.

LITERATURE CITED

Jorgensen, H.E., and R.J. Mackie. 1978. Evaluation of range survey methods, concepts, and criteria. Job Prog. Rep., Fed. Aid Proj. W-120-R-9, Study H-1.1, Job 1. Mont. Dept. of Fish and Game, Helena. 8 pp. (multilith).

Submitted by: Henry E. Jorgensen

STUDY NO. BG-1.0 JOB NO. 2 (Supplement)

JOB TITLE: Behavior and survival of mule deer fawns during summer in the Missouri River Breaks, Montana.

JOB OBJECTIVES: 1. To determine the extent, timing, and causes of summer fawn mortality in the Missouri River Breaks, and,
2. To determine the movements, home ranges, activity habits, habitat use and other behavioral characteristics of mule deer fawns and relate those variables to mortality.

FINDINGS:

This study was conducted as a graduate (MS) thesis research project within the framework of studies of the population ecology and habitat relationships of mule deer in river breaks habitat in northcentral Montana. Field work was completed in the fall of 1980 and the final thesis report was submitted in January 1982 as a supplement to the 1981-82 progress report for Study No. BG-1, Job No. 2. An abstract of that thesis, titled "Survival and behavior of radio-collared mule deer fawns during summer, 1978-1980, in the Missouri River Breaks, Montana", by Shawn J. Riley, is presented below.

ABSTRACT:

A study to determine the causes and extent of mortality among mule deer fawns and to evaluate how behavior and habitat use affect early fawn survival was conducted in the Missouri River Breaks, northcentral Montana, during the summers of 1978, 1979, and 1980. Forty-nine fawns were equipped with radio transmitters: 15 in 1978, 18 in 1979, and 16 in 1980. One-third of the total summer mortality (1 fawn each summer) was attributed to starvation due to abandonment. Known and/or suspected predation by coyotes resulted in fawn mortality rates of 16.7%, 11.8%, and 13.3% in 1978, 1979, and 1980, respectively. The low mortality occurred despite a stable to slightly increasing coyote population. Dense growth of yellow sweetclover during 1978 and 1979, an abundance of alternative prey for coyotes during all years, and changes in habitat use by fawns in 1980, apparently were important in reducing predation and increasing survival during the study period as compared with 1976 and 1977. Movements of fawns between relocations ranged from 0.00 to 3.85 kilometers, with an overall mean of 0.78 kilometers. Monitored fawns made greater movements in 1978 than in 1979 and 1980. Summer home ranges of fawns varied in size from 23 to 350 hectares and averaged 133 hectares through the study period. The average size decreased

significantly from 211 hectares in 1978 to 100 hectares and 105 hectares in 1979 and 1980, respectively. Home ranges frequently overlapped, but complete overlap was observed only in 1980. The extent to which fawns utilized cover types differed significantly between early and late summer and between years. Decreased use of the open types occurred each year as summer progressed. Fawns utilized the *Pinus-Juniperus* and *Pseudotsuga-Juniperus* cover types earlier and to a greater extent in 1980 than in 1978 or 1979. Marked fawns selected bedsites that provided an average of 69% concealment cover from 3 sides. The amount of cover surrounding fawn bedsites did not differ significantly between years. Results indicated that predation patterns and rates within and between years were not a function of coyote numbers alone, but reflected complex interaction between coyotes, the availability and abundance of alternative prey, and environmental conditions that determine the vulnerability of fawns.

STUDY NO. BG-2.0 JOB NO. 1

JOB TITLE: Population ecology and habitat relationships of white-tailed deer in coniferous forest habitat of northwestern Montana.

ABSTRACT:

Studies to evaluate factors affecting populations of white-tailed deer (*Odocoileus virginianus*) in the Swan Valley, Montana, were continued during 1981-82. Also, a study to evaluate white-tailed deer populations in the Tally Lake area was initiated. Data collected at the lower Swan Valley checking station included information on the harvest, hunting and harvest distribution, age structure, and weights and body measurements. Age classifications indicated fawn/adult ratios of 38/100 and 32/100 on the Swan Valley and Tally Lake study areas, respectively. A total of 58 deer was captured, marked for individual recognition, and released on the Tally Lake study area. The sex and age composition of that sample differed from the previous trapping sample in the Swan Valley. Movements of radio-collared deer suggested that habitat use and migratory behavior may differ between the Swan Valley and Tally Lake populations.

JOB OBJECTIVES

1. To determine basic biological and ecological parameters of white-tailed deer populations associated with coniferous forest habitats in northwestern Montana;

2. To relate those basic parameters to (a) characteristics of individual habitats or environments and (b) specific potential limiting factors associated with individual populations and habitats, including nutrition, other wild ungulates, logging and associated forest management practices, subdivisions and associated human activity, weather, and hunting;

3. To further develop and test hypotheses relating to deer-habitat interactions and population regulation; and

4. To develop new methods, criteria, and guidelines for deer management, generally, and specifically for coniferous forest habitats.

INTRODUCTION

The white-tailed deer (*Odocoileus virginianus*) is the most abundant and widely distributed big game species in northwestern Montana. Its distribution is closely associated with the mature coniferous forest. Recent trends have indicated reduced populations, concurrent with the development of large areas of deer habitat for other values.

Montana Statewide Deer Research included a study to evaluate factors affecting white-tailed deer in the Swan Valley. That area long has been an important deer range and is representative of a major ecological type in which white-tailed deer occur. The study has emphasized the collection of information basic to the distribution, movements, habitat use, and population dynamics.

The Northwest Montana White-tailed Deer Study was expanded during FY82 to include a study of white-tailed deer in the vicinity of Tally Lake. The emphasis of this study is similar to that in the Swan Valley.

STUDY AREA

The Swan River Valley occurs in southeastern lake and northeastern Missoula Counties. The valley lies between the Swan Range and the Mission Mountains and extends from the Swan-Clearwater Divide north, approximately 40 miles, to Swan Lake (Fig. 1). The primary winter range lies between Goat Creek and Condon. Condon is approximately 70 miles northeast of Missoula and 65 miles southeast of Kalispell.

Hildebrand (1971) and Antos (1977) described the Swan Valley. The history of the deer population and summaries of early studies were presented by Weckwerth (1958), Hildebrand (1971), and Mundinger (1976).

Tally Lake is 10 miles west of Whitefish and 17 miles northwest of Kalispell. Tally Lake is a principle feature within an unnamed range of hills and low elevation mountains that extend from U.S. Highway 2, approximately 10 miles west of Kalispell, north and northwest to the Tobacco Valley, near Eureka. Within that range, the study area has been arbitrarily defined by the boundaries of Martin Creek on the north, the Stillwater River on the east, McMannamy Draw on the south, and from the head of McMannamy Draw northwest to Ingalls Mountain and thence north to Fox and Grouse Mountains. Within the study area, Martin Creek, Good Creek, and Logan Creek, which flows through Tally Lake, are prominent tributaries of the Stillwater River. Sheppard Creek and Griffin are prominent tributaries to Logan Creek and Star Meadows occurs at the confluence of the three creeks.

White-tailed deer winter along the eastern fringe of the range of hills, from Pilot Knob south to Ashley Creek. The study is concerned with this population of animals,and especially the segment that winters in the vicinity of the Ray Kuhns Wildlife Management Area (RKWMA) (Figure 2). That wildlife management area was formed by the merger of lands acquired by the Montana Department of Fish, Wildlife, and Parks from the estate of Ray Kuhns with the former Bowser Lake Wildlife Management Area. RKWMA now includes 1,512 acres of deeded land and 79 acres of land which are leased from the Montana Department of State Lands.

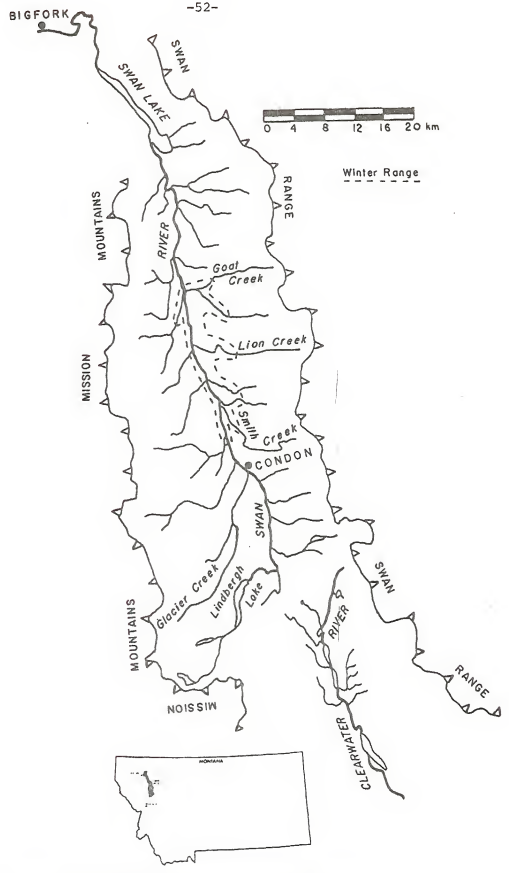

Figure 1. Map of the Swan River Valley Study Area.

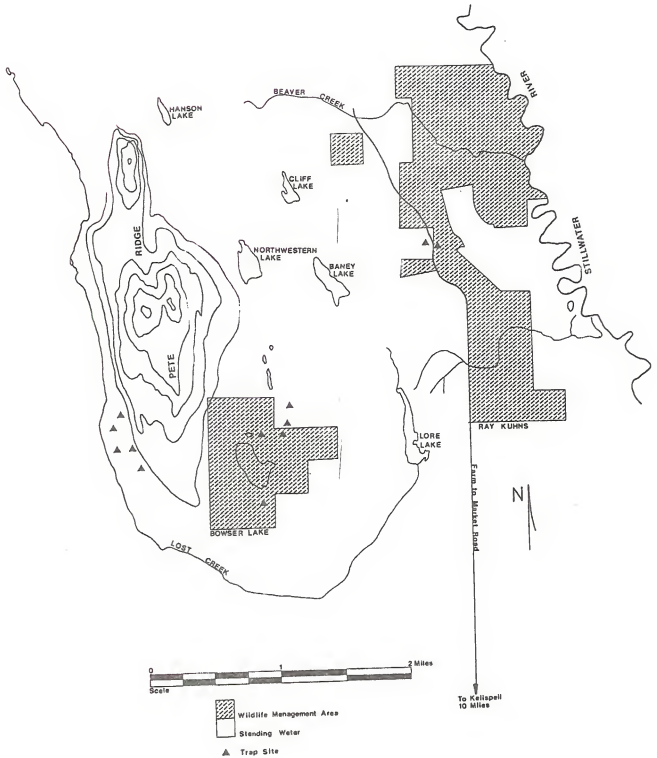

Figure 2. Map of the RKWMA study area.

Bowser Lake is 10 miles northwest of Kalispell. The RKWMA is accessed by the Farm to Market Road (Flathead County Road 424). Principle features of the area include the Stillwater River, Pete Ridge, the Lost Creek.

The RKWMA is occupied by mature, coniferous forest. The *Pseudotsuga menziesii/ Symphoricarpos albus* H.T. (Pfister et al. 1977) is the major habitat type on the area. Douglas fir (*Pseudotsuga menziesii*) is the dominant species in a mixed overstory that also includes western larch (*Larix occidentalis*), lodgepole pine (*Pinus contorta*), and a minor component of ponderosa pine (*Pinus ponderosa*). The *Picea/Clintonia uniflora* H.T., in which spruce (*Picea* spp.) is dominant, occurs along the Stillwater River and as minor inclusions near Bowser Lake. Major species in the forest understory include common juniper (*Juniperis communis*), snowberry (*Symphoricarpos albus*), pine grass (*Calamagrostis rubescens*), white spirea (*Spiraea betulifolia*), kinnikinnic (*Arctostaphylos uva-ursi*), and Oregon grape (*Berberis repens*). The understory also includes sparse amounts of serviceberry (*Amelanchier alnifolia*), mountain maple (*Acer glabrum*), and huckleberry (*Vaccinium* spp.). Arboreal lichens (*Allectoria* spp.) are common.

The climate in the vicinity of the RKWMA is milder than that which is typical of northwestern Montana. Average daily temperatures range between -7 and 19 C, and recorded extremes have been -37 and 38C. The average annual precipitation is 42 cm, most of which occurs as snow. The average growing season is 105 days.

METHODS

Methods employed in the study were previously described (Mundinger 1980). During FY82, the primary field effort occurred on the Tally Lake Study Area, while a monitoring level was maintained in the Swan Valley.

A part-time checking station was operated in the Swan Valley during the 1981 hunting season. Hunters were interviewed to determine hunter origin, drainages hunted, and locations of animals observed and harvested. Ages of harvested animals were determined (Severinghaus 1949; Robinette et al. 1957; Quimby and Gaab 1957; Gilbert 1966). Weights and body measurements of white-tailed deer also were collected.

In the Swan Valley, 16 radio telemetry-equipped deer, collared during earlier years, were available for study. During the 1981-82 winter, one of these animals died and transmitters failed on 4 others. These radio-equipped animals were periodically relocated, primarily by fixed-wing aerial surveys. Two replications of the trend route in the Swan Valley study area were conducted.

Several Clover traps (Clover 1954) were continually maintained on and adjacent to the RKWMA during early January through mid-March. Two traps were set on the ridge between Rhodes and McMannamy Draws. That effort was terminated because of interference from stray dogs. Three traps also were set in the area of Ashley Creek, but that effort occurred too late in the winter to be productive. A total of 30 fawn and adult females was marked with metal ear tags and plastic neckbands, and 8 fawn and adult males were marked only with ear tags. Twenty yearling and prime-age females were fitted with radio telemetry collars. During 1979, six adult females had been equipped with transmitters. Of those, 2 were functioning during this project period.

Table 1. Summary of 1975-1981 hunting seasons in the Swan Valley.

	1975	1976	1977	1978	1979	1980	1981
Season Format	10/19-	10/24-	10/23-	10/22-	10/21-	10/19-	10/25-
Either sex	11/9	10/31	10/30	10/29	10/28	10/26	11/1
Males Only	11/10-	11/1-	10/31-	10/30-	10/29-	10/27-	11/2-
	11/23	11/28	11/27	11/26	11/25	11/30	11/29
Hunter Days							
Questionnaire	40,511	33,606	39,691	31,653	30,914	28,244	23,550
Check Station	2,750	3,317	3,239	3,016	2,640	2,959	2,591
White-tail Deer Harvest							
Questionnaire	635	523	736	625	612	746	668
Check Station	98	104	154	124	150	208	172
Mule Deer Harvest							
Questionnaire	70	94	86	69	96	128	112
Check Station	13	15	24	12	12	28	14
Elk Harvest							
Questionnaire	293	125	222	135	123	155	112
Check Station	51	29	39	29	29	35	37
White-tail, % adult males							
Questionnaire	55	74	79	79	67	71	72
Check Station	49	66	68	66	41	53	55
Deer Hunters							
(Questionnaire)	4,501	3,673	4,323	3,779	3,647	3,704	2,536
% Deer Hunter Success							
(Questionnaire)	17	17	20	18	20	24	31

Field surveys were conducted in the vicinity of the RKWMA throughout the winter. Information obtained included numbers of deer observed, numbers of fawns, numbers of adults, location, a general description of the habitat, and identification of marked animals.

Radio-collared animals were periodically relocated, both from the ground by triangulation and from fixed-wing aerial surveys. After dispersal, the field effort primarily involved relocating these animals. Other deer observations, obtained incidental to that effort, also were recorded.

During spring, deer in the vicinity of the RKWMA traditionally form large aggregates. These groups are easily observed when deer forage in the agricultural fields adjacent to the range of hills. A vehicle route was established to census deer during that period. The route began at the intersection of the McMannamy Draw and Farm to Market Roads and followed a system of Flathead County roads to the northern boundary of the RKWMA. The route was driven during early evening and was completed after sunset. Three replications of the route were conducted. An attempt was made to obtain a complete census of all deer that were visible from the route. When observed, deer were classified to age, and, when possible, to sex.

An analysis of deer summer habitat relationships was completed during the project period. Results of that study are reported elsewhere (Leach 1982).

RESULTS AND DISCUSSION

The 1981 hunting season in the Swan Valley spanned 5 weeks. This included 8 days of either-sex and 4 weeks of males-only hunting. Hunting season parameters, as determined from the lower Swan Check Station and the Montana big game questionnaire, are presented for the 1975-81 hunting seasons in Table 1. These indicate an average annual harvest of 650 white-tailed deer over the 7-year period, and a preponderance of adult males in the harvest. The questionnaire data suggested decreases in hunter numbers and hunter days in 1981, disproportionately greater than that indicated by numbers of hunters interviewed at the check station. Perhaps this difference was influenced by a change from a mail survey to a telephone survey during 1981. Three marked deer were harvested and reported during the 1981 hunting season.

The sex and age composition of the 1981 white-tailed deer harvest is presented in Table 2. Representation of fawns, yearlings, and 2½-year-olds in both sexes was comparable to that in prior years (Mundinger 1981a), while 3½-year-olds were poorly represented. Analysis of animals in the older age-classes has not been completed.

Table 2. Number of white-tailed deer by sex- and age-class, harvested in the Swan Valley during 1981.

Sex	Age-Class ½	1½	2½	3½	4+
Males	13	53	20	3	20
Females	20	21	6	2	14

Hog-dressed weights and body measurements were determined at the check station. Those data suggested that females increased in size and weight through at least 3½-years, while males increased through 5½-years (Mundinger 1981a). Weights and measurements of older deer, harvested in 1981, will be included in this sample when the analysis of age data is completed.

Fawns of both sexes in the 1979 year-class were lighter and smaller than those in other year-classes (Table 3). Consistent with that observation, yearlings in 1980 (Table 4) and 2½-year-olds in 1981 (Table 5) were the lightest animals in each of those respective age-classes. Animals in the 1979 year-class were conceived after the "normal" 1977-78 winter and were born after the 1978-79 winter which was the most severe winter during the period of this study.

Fawns in the 1976 year-class, animals born after the mild 1975-76 winter, were heavy. Consistently, yearlings in 1977 and 2½-year-olds in 1978 also were heavy.

A similar relationship perhaps should have been apparent for the 1977 year-class, because those animals were born after two successive mild winters. That relationship could not be demonstrated primarily because individual weights among animals in the 1977 year-class were more variable than those of the 1976 year-class. That variability was consistent among fawns, yearlings, and 2½-year-olds in the 1977 year-class during each of the corresponding years. Variability in weight among individuals may have occurred because recruitment during 1977-78 was above average and because an above average number of younger does (2½- and 3½-year-olds) reared young to recruitment age that year (Mundinger 1981b).

A total of 188 white-tailed deer was observed during two replications of the upper Swan Valley trend route. That sample suggested a recruitment rate of 27.7% during 1982. Estimates of recruitment from trend route samples in the Swan Valley generally have been similar to estimates derived from larger number of observations throughout the winter (Mundinger 1980).

Table 3. Average hog-dressed weights and body measurements of white-tailed deer fawns, harvested in the Swan Valley.

	1975	1976	1977	1978	1979	1980	1981
Females							
Weight (lbs.)	58	63	60	53	55	60	63
Length (cm.)			114.4	114.1	114.4	115.3	120.8
Height (cm.)			78.7	76.8	76.4	78.3	80.8
Hind Foot (cm.)			40.9	40.8	40.3	41.0	41.3
Males							
Weight (lbs)	63	63	67	64	59	65	63
Length (cm.)		117.1	115.6	116.9	114.8	120.0	114.9
Height (cm.)		76.4	83.0	79.6	78.9	82.1	81.0
Hind Foot (cm.)		41.9	42.6	42.4	41.3	42.2	42.5

Table 4. Average hog-dressed weights and body measurements of yearling white-tailed deer harvested in the Swan Valley.

	1975	1976	1977	1978	1979	1980	1981
Females							
Weight (lbs.)		95	101	99	96	91	95
Length (cm.)		133.8	132.2	132.2	138.0	130.8	139.5
Height (cm.)		84.8	89.3	91.8	89.4	89.7	89.4
Hind Foot (cm.)		45.1	46.2	45.4	45.7	45.4	45.6
Male							
Weight (lbs.)	119	111	114	116	112	108	115
Length (cm.)		139.6	141.6	140.7	142.4	139.9	141.4
Height (cm.)		92.0	94.7	95.1	94.3	93.0	95.4
Hind Foot (cm.)		47.6	48.1	47.7	47.5	47.4	48.0

Table 5. Average hog-dressed weights and body measurements of 2½-year-old white-tailed deer harvested in the Swan Valley.

	1975	1976	1977	1978	1979	1980	1981
Females							
Weight (lbs.)	102	108	107	107	107	101	98
Length (cm.)		140.0	138.5	140.5	143.0	141.3	141.5
Height (cm.)		90.5	91.3	92.4	91.8	90.4	89.5
Hind Foot (cm.)		46.3	46.5	47.9	46.5	45.8	45.3
Males							
Weight (lbs.)	159	148	140	151	139	136	133
Length (cm.)		155.3	147.1	151.6	148.3	148.8	151.3
Height (cm.)		98.1	100.0	99.6	100.4	99.4	98.4
Hind Foot (cm.)		49.9	49.4	49.9	48.6	49.2	48.5

The average recruitment rate in the Swan Valley was 29.8±1.68% for the period 1976-1982. Similar recruitment rates were determined each year (Table 6) except that recruitment was highest ($p < 0.10$) during 1978. Higher recruitment that year may have been in response to two successively mild winters and above average recruitment of fawns by younger does. The 1982 biological year also followed two mild winters and recruitment that year was low, although the confidence interval for that estimate was large because the sample size was small.

Table 6. Classification of white-tailed deer in the Swan River Valley, 1976-1982.

Year	Total	Adults	Fawns	Fawns/100 Ad.	% Fawns
1976	2,119	1,519	600	39	28.3 ± 1.61[a]
1977	3,439	2,429	1,010	42	29.4 ± 1.28
1978	4,002	2,707	1,295	48	32.4 ± 1.22
1979	3,064	2,224	840	38	27.4 ± 1.32
1980	3,889	2,726	1,163	43	29.9 ± 1.21
1981	233	155	78	50	33.5 ± 5.10
1982	188	136	52	38	27.7 ± 5.38

[a] 0.90 confidence interval

A total of 313 white-tailed deer was observed in the vicinity of the RKWMA during mid-winter surveys. The corresponding classification was 37 fawns/100 adults, or a recruitment rate of 27.1% (Table 7). A total of 603 deer was observed during three replications of the spring survey, and the corresponding recruitment rate was 24.0%. Although these values were statistically similar ($p > 0.10$), they suggested that differentially greater fawn mortality, relative to adults, may have occurred during March.

Table 7. Classification of white-tailed deer in the vicinity of the RKWMA winter range, 1982.

Date	Total	Adults	Fawns	Unid.	Fawns/ 100 Adults	% Fawns
Mid-winter	313	218	81	14	37	27.1 ± 4.24[a]
5 April 82	151	118	32	1	27	21.3
7 April 82	265	194	69	2	36	26.2
19 April 82	187	144	43		30	23.0
Spring Total	603	456	144	3	32	24.0 ± 4.24

[a] 0.90 confidence interval

Recruitment estimates for 1982 in the RKWMA, derived from the mid-winter survey, were less than the long-term average in the Swan Valley, but similar to the 1982 estimate for that area. The recruitment estimate derived from the spring survey in the Bowser Lake area was significantly less ($p < 0.10$) than the long-term average in the Swan Valley.

A total of 61 white-tailed deer was captured in the vicinity of the RKWMA. Fawns and adult females were predominant in the sample of captured animals (Table 8). The sex- and age-structure of the trapped sample differed significantly ($X^2 = 17.415$; d.f. = 4; $p < 0.005$) from the cumulative trapping sample in the Swan Valley (Table 9). The RKWMA sample included fewer adult males ($p < 0.01$) and more old adult (4+ -years) females ($p < 0.10$) than expected.

The total number of fawns in the RKWMA sample was similar to that expected from the proportion of fawns in the Swan Valley sample. The ratios of fawns/adult females also were similar. However, the sex ratio of fawns in the RKWMA sample was significantly different from the Swan Valley sample ($X^2 = 7.08$; d.f. = 1; $p < 0.01$). In the Swan Valley, 46% of the captured fawns were females and a 50/50 fawn sex ratio was suggested ($p = 0.15$). At the RKWMA, 76% of the captured fawns were females and the fawn sex ratio differed significantly from 50/50 ($p < 0.01$). Presumably, that difference occurs because fawn mortality, prior to recruitment age, in the RKWMA is differentially greater among males.

Table 8. Number of white-tailed deer, by sex- and age-class, captured in the vicinity of the RKWMA winter range, 1982.

	Age-Class				
Sex	½	1½	2½	3½	4+
Males	6	2		1	
Females	19	9	4	2	18

25 fawns/33 females = 76 fawns/100 females

Table 9. Number of white-tailed deer by sex- and age-class captured on the Upper Swan Valley winter range 1976-1980 (Mundinger 1980).

	Age-Class				
Sex	½	1½	2½	3½	4+
Males	94	25	8	6	14
Females	81	52	38	38	94

175 fawns/222 females = 79 fawns/100 females

Recruitment was similar on the two study areas during 1982. It is interesting that this similarity occurred despite apparent major differences in the sex ratios of both fawns and adults in the two populations.

Analysis of habitat use in the Tally Lake area is preliminary and only general statements are possible at this time. Concentrated deer use on the RKWMA occurred on Lost Creek bottom and in the vicinity of the small potholes north of Bowser Lake. Concentrated deer use also may have occurred in riparian habitat adjacent to the Stillwater River, but the sample of radio-collared deer did not include individuals that wintered in that area. Concentrated deer use in riparian habitats was less pronounced than that which occurs in the Swan Valley (Mundinger 1980), probably because riparian habitats are limited on the RKWMA. By comparison with deer in the Swan Valley, deer on the

RKWMA were more mobile, less dependant on specific activity centers, and may have used larger winter home ranges. Similar to the Swan Valley, winter deer use on the RKWMA occurred, almost exclusively in the coniferous forest.

A change in habitat use within the vicinity of the RKWMA winter range was the first indication that dispersal was imminent. This was evidenced by the occurrence of large groups of deer in the snow-free fields adjacent to the winter range. Coincident with this change, the size of individual home ranges of some deer increased, while other deer left the area entirely.

Dates of departure from the winter range were determined from single movements by 18 of the 22 radio-equipped deer. Of the remainder, one deer died on the winter range and the transmitter on a second deer functioned sporadically during the first 3 months of operation. Movements of 2 deer were erratic, in comparison with movements by other instrumented deer, and a single movement of dispersal could not be determined.

Dispersal by instrumented deer spanned a 47-day period, from 10 March to 25 April (Table 10). Of the 18 deer followed, 16 dispersed during a 13-day period, from 8 April to 25 April. The first reports of neck-banded deer at locations away from the winter range were obtained during the second week of March. Similar to other studies (Mackie and Knowles 1977; Mundinger 1979), dispersal occurred as individual behavior, rather than as a mass migration.

Deer from the RKWMA winter range were spread over an area of 456 square km during spring-early summer (Figure 3). Seven of the deer were located in an area of approximately 31 square km, in and adjacent to Star Meadows.

Three migration routes between the RKWMA winter range and the summer range were apparent. The Lost Creek drainage was the route used by eight deer. These animals used "staging areas" located near Pilot Knob and, again, near the inlet of Logan Creek to Tally Lake. Seven deer moved through the trench between the ridge east of Tally Lake and the Stillwater River. Pronounced "staging areas" were not apparent on this route, perhaps because several locations were suitable, but each of these 7 deer remained at locations within the trench for a period, prior to a second movement. One of these deer died, probably from predation, during the spring. Two deer moved from the RKWMA to Mountain Meadows and thence over Reid Divide to Star Meadows. A third deer, the last to leave the RKWMA, apparently followed this route as well. However, she moved directly to Star Meadows without first "staging" at Mountain Meadows.

Such distinct migration routes were not apparent in the Swan Valley (Mundinger 1980). This difference probably is related to differences in topography between the two areas.

Seventeen of 18 deer, that eventually occupied summer ranges in the vicinity of Tally Lake, dispersed from the winter range by two distinct movements. They first moved from the winter range to a definable spring home range ("staging area") and moved again, during late May-early June, to their respective, definitive summer home ranges. Only a small proportion of the animals followed in the Swan Valley used definable spring home ranges (Mundinger 1980). This difference between these populations may be real.

Table 10. Dates of departure from the RKWMA winter range by 18 radio-equipped white-tailed deer females.

Time Period	3/7-13	3/14-20	3/21-27	3/28-4/3	4/4-10	4/11-17	4/18-24	4/25-5/1
Number of Deer	1	0	0	1	4	5	6	1

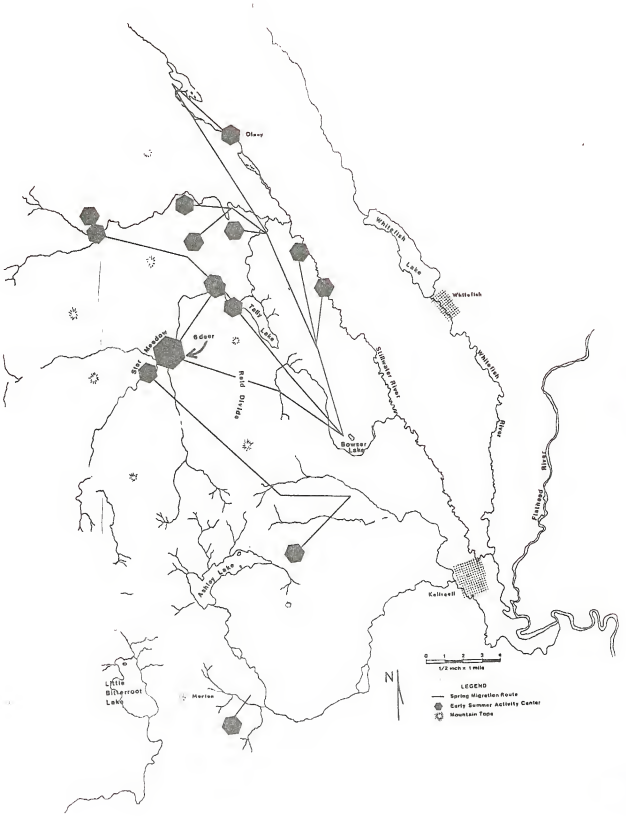

Figure 3. Dispersal of white-tailed deer from the RKWMA during spring, 1982.

It also may have been that such a distinct use of spring ranges by deer in the Tally Lake area during 1982 was exaggerated in response to unusually cool, wet spring weather.

Two different patterns of summer range use were evident from the manner by which radio-equipped deer used habitats in the vicinity of Tally Lake. Thirteen of these deer used summer home ranges similar to those previously described for the Swan Valley (Mundinger 1980; Leach 1982). These animals used summer home ranges of approximately 160 acres. Within that area, activity centers occurred in riparian habitats and a mature coniferous forest was the dominant cover type. A preliminary analysis suggested that prominent Habitat Types (Pfister et al. 1977) included *Abies lasiocarpa/ Clintonia uniflora* and *Thuja plicata/Clintonia uniflora*.

A distinct summer concentration of white-tailed deer occurred in the vicinity of Star Meadows. That concentration was evident from frequent observations of deer. Also, the summer home ranges of seven radio-collared deer occurred in that area. Star Meadows may have provided summer habitat for deer from diverse wintering areas because the sample of radio-collared deer included one of the animals that had been captured near Rhodes Draw.

Apparently, summer range use by those deer which used Star Meadows differed from summer range use by other deer in the Tally Lake area. Three of the radio-collared deer first occupied areas on timbered ridges adjacent to Star Meadows. Then, they occupied small areas, wholly within Star Meadows, from early June to late July-early August. Thereafter, they returned to the respective areas that they had used during late Spring. A fourth deer behaved similarly, except that the timbered stand that she used in late spring and again in late summer was contiguous with Star Meadows. Thus, changes in habitat use occurred but a distinct movement was not apparent. A fifth deer also behaved similarly, except that her spring range was located near the head of Rhodes Draw while her late summer range occurred on a ridge near Star Meadows. Two deer first occupied small areas in Star Meadows during early June and they remained there through early August.

These observations are preliminary, but they suggest that Star Meadows is an important fawn-rearing habitat. However, the area either may not provide optimum habitat during the entire late spring - late summer period, or high densities in that area may not be possible during periods when adult does have greater mobility.

Star Meadows is an extensive area of riparian habitat and is a unique feature in the Tally Lake area. Three cover types are prominent. Extensive stands of deciduous shrubs, primarily willow *(Salix* spp.) with lesser amounts of red osier dogwood *(Cornus stolonifera)*, occur contiguous with flowing water. These are interspersed with large, grassy meadows. Most of the meadow area was wet during late spring-early summer. In portions of the meadow, cottonwood *(Populus trichocarpa)* stands have replaced the shrub fields. Spruce may be a potential climax species in Star Meadows, but it is dominant only in small, isolated stands. Generally, spruce occurs as scattered individuals within the cottonwood stands or, occasionally, in the shrub fields. While in Star Meadows, the activity centers of individual deer occurred either in the shrub fields or in timbered areas.

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Shawn J. Riley

STUDY NO. BG-2.0 JOB NO. 1 (Supplement)

JOB TITLE: Summer range ecology of white-tailed deer in the coniferous forests of northwestern Montana.

JOB OBJECTIVES: 1. To identify and describe summer habitat of white-tailed deer in the Swan and northern Clearwater River drainages; and

2. To evaluate the possible influences of fire and logging on summer habitat.

FINDINGS

This study was conducted as a graduate (MS) thesis research project within the framework of studies of the population ecology and habitat relationships of white-tailed deer in coniferous forest habitats in northwestern Montana. Field work was completed in the fall of 1981 and the final thesis report was submitted in July 1982 as a supplement to the 1981-82 progress report for Study No. BG-2.0, Job No. 1. An abstract of that thesis by Rosemary H. Leach is present below.

ABSTRACT

During 1980 and 1981, I studied the ecology of white-tailed deer (Odocoileus virginianus) on the Swan-Clearwater summer range, northwestern Montana. Summer home ranges were well dispersed over the study area. Deer monitored both summers established their ranges in the same areas each year. Average home range size was 71 ha for adults and 91 ha for yearlings. Three deer followed for 24-hour periods confined movements inside or near to home ranges delineated during daytime tracking. Adult home ranges contained significantly more riparian and unlogged upland habitats, and significantly less logged upland than expected. Habitat composition within home ranges of yearlings more closely paralleled composition on the entire study area, except yearlings had significantly more logged riparian habitat than expected. Yearling ranges were composed largely or marginal (logged) habitats, most commonly logged riparian habitat with abundant deciduous cover, remnant conifers, and high diversity. Deer ranges also contained siginificantly more cool site and riparian habitat types and topographic features, mature subclimax coniferous forest, and diversity than expected. Adults and yearlings selected similar habitats within home ranges. Both used riparian habitats, both unlogged and logged, significantly more than expected, and upland habitats, both unlogged and logged, significantly less than expected. Management implications included: 1) protect riparian areas from logging; 2) retain unlogged coniferous forest around riparian areas; 3) plan cutting units as small (< 12ha) and as scattered as possible ($\leq$ 5 per section); and 4) plan additional entries only after second growth in logged units is sufficiently developed to provide hiding cover.

STUDY NO. BG-2.0 JOB NO. 3

JOB TITLE: Population ecology and habitat relationships of white-tailed deer in river bottom habitat in eastern Montana.

ABSTRACT:

A study to evaluate factors affecting populations of white-tailed deer (Odocoileus virginianus) on islands and floodplain of the lower Yellowstone River was continued in 1981-82. Intensive research was continued in 3 units located between Glendive and Sidney, Montana. Fall aerial classification indicated a fawn:adult female ratio of 96:100 (154:100 producing females), which compared to a ratio of 93:100 for individually marked females based on differential productivity by age class. Sixty percent of the adult females (1½+) successfully reared fawns to fall 1981. Ninety-one percent of the fall (prehunt) population consisted of deer 4½ years and younger. A fetal rate of 187:100 was observed among a sample of adult females (1½+) during winter and spring 1982. Deer densities of 58 and 40 deer/mi^2 were observed at the Elk Island and Intake study units respectively during early spring 1982. A population increase of 19 percent was noted in the Elk Island unit from spring 1981 to spring 1982. Seasonal habitat use and harvest data were also evaluated during the report period.

INTRODUCTION

Riparian communities, associated with major streams and rivers, provide important habitat for white-tailed deer (Odocoileus virginianus) in eastern Montana. The distribution of this species in eastern Montana just prior to 1941 was limited almost exclusively to the Missouri River and its major tributaries and to the extreme lower Yellowstone River (Allen 1971).

The lower Yellowstone was selected for study because it is representative of a major ecological community in which white-tailed deer occur in eastern Montana and because the floodplain habitats occupied may be subjected to alteration as a result of future demands for water for energy development. Quantitative data on animal/habitat/environmental relationships of white-tailed deer associated with these habitats are generally lacking.

This report updates findings from a research project initiated in July 1980 (Dusek 1981). Included are the results of general monitoring of population phenomena and distribution of whitetails on the segment of river bottom between Glendive and Sidney, Montana. Intensive research was also continued in the 3 units in and near the Elk Island and Seven Sisters Wildlife Management Areas and near Intake. Previous work on white-tailed deer on the latter unit includes that of Swenson (1978a). Research on successional relationships of riparian communities was conducted during the summers of 1980 and 1981 (Boggs 1981).

STUDY AREA

The study area (Figure 1) includes approximately 53 miles of river floodplain and islands between Glendive and Sidney, Montana. This stretch of river bottom, which lies entirely in hunting district 750, crosses portions of Dawson, Wibaux and Richland Counties. Three areas, which take into consideration the various kinds of agricultural practices along the lower Yellowstone, were selected for intensive study (Figure 1). Land use practices as well as physiography and vegetation were described previously (Dusek 1981, Boggs 1981).

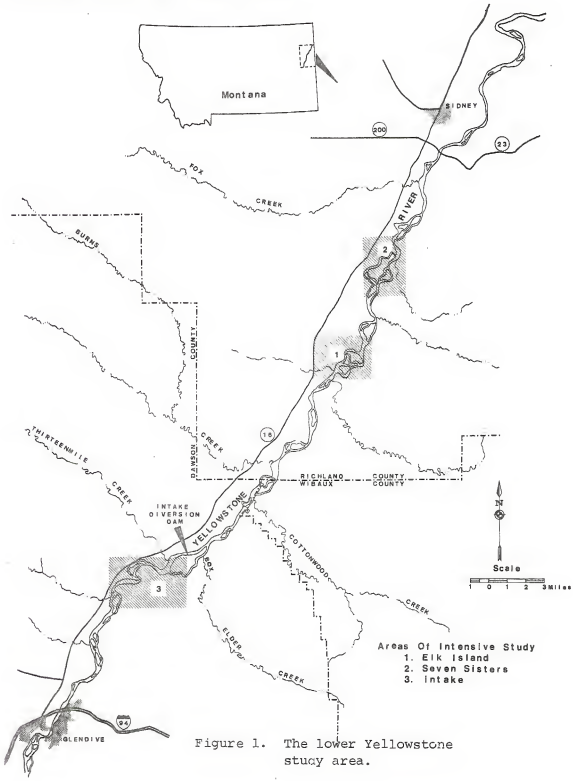

Figure 1. The lower Yellowstone stucy area.

Winter 1981-82 included larger periods of cold temperatures, greater snowfall and more persistant snow cover than the previous 2 years (Table 1). However, weather severity (Picton and Knight 1969) approximated the average for the 5-year period ending March 1982.

Table 1. Climatological data and weather severity indices for the period on mid-November through March from weather records gathered at Sidney, Montana.

Year	No. days w/[a] temp. below freezing (F)	No. days w/[b] snow on ground	Total Precip. (in.)	Max. snow depth (in.)	Severity[c] Index
1977-78	93	122	2.40	15	+17,835
1978-79	99	137	2.69	25	+24,028
1979-80	62	69	1.30	10	+1,565
1980-81	40	25	0.99	7	-600
1981-82	72	113	3.92	19	+13,242
Average	73	93	2.26	15	+11,214

[a]Indicates number of days in which maximum daily temperature did not exceed 32°F.

[b]Indicates number of days in which there was 1 or more inches of snow cover.

[c]Weather Severity Index is from Picton and Knight (1969).

METHODS

Procedures generally followed those of Dusek (1981). A ratio of fawns: producing female was determined from data obtained incidental to aerial tracking transmittered deer during July-September. Reproductive success was also determined for individually marked females. Additional data regarding age structure and longevity of the population were obtained from deer killed on depredation permits issued during January-February 1982. Reproductive potential of the population was estimated from examination of reproductive tracts of all age classes of females during the period of January-May 1982. Ovulation and fetal rates were also determined. An additional 100 deer were captured and individually marked along the river bottom January-March 1982. Of those, 28 were equipped with transmitter collars.

RESULTS

Population Characteristics

Herd Composition and Longevity

Deer aged 4½-years-and-younger comprised 91 percent of the pre-hunt population of white-tailed deer along the lower Yellowstone during fall 1981 (Figure 2). This suggested a relatively young age structure as was also observed during fall 1980 (Dusek 1981).

Sex and age specific composition of the population was determined using supplementary data obtained from fall aerial classifications together with harvest composition of females older than fawns and males older than yearlings. Herd composition, as determined from aerial classification during fall, early winter and early spring, is shown in Table 2. Composition by sex and age of deer that were harvested, killed on highways, killed on depredation permits, and those trapped for marking appear in Tables 3, 4, 5, and 6, respectively.

Fawns accounted for 41 percent of the 1981 pre-hunt population (Table 2). Male and female fawns apparently occurred in nearly equal proportions. An aggregate sample of harvested, road-killed and collected specimens included 28 female and 27 male fawns. A preponderence of male fawns in samples of trapped deer during all years suggested that they were more vulnerable to trapping than other sex and age classes.

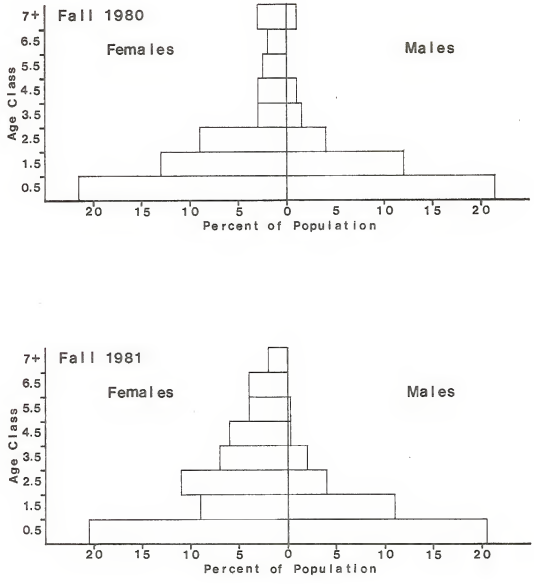

Figure 2. Composition by sex and age of fall populations (pre-hunt) during 1980-81.

Table 2. Seasonal herd composition by sex and age of white-tailed deer along the lower Yellowstone in hunting district 750.

Year	Number Classified	Percent Males 2½+	Percent Males 1½+	Percent Females 1½+	Percent Fawns	Fawns: 100 Fem. 1½+	Fawns: 100 Ad. 1½+
			Fall (Pre-hunt)				
1977[a]	375	10[b]	--	53	37	68	58
1978	42	7	--	43	50	117	100
1979	125	14	--	36	50	140	102
1980[c]	540	6	12	39	43	112	76
1981	334	5	11	43	41	96	69
			Early Winter				
			---------Percent Adults---------				
1981	687		55		45	--	81
1982	1581		55		45	--	82
			Early Spring				
1981	425		55		45		82
1982	490		59		41		68

[a]Pre-hunt data for 1977-79 are from Region 7 annual progress reports (Swenson 1978b, Swenson and Knapp 1979, Swenson 1980).

[b]Yearling and older males were not separated in samples of 1977-79.

[c]Data from 1980-82 are from the ongoing study.

Table 3. Percent composition by age of 185 white-tailed deer harvested along the Yellowstone River in hunting district 750 during 1980-81.[a]

Age Class	Females 1980 (33)[b]	Females 1981 (30)	Males 1980 (43)	Males 1981 (79)	Total 1980 (76)	Total 1981 (109)
½	15	23	7	10	11	14
1½	27	17	53	38	42	32
2½	21	20	16	33	18	29
3½	6	13	16	16	12	16
4½	9	10	5	1	7	4
5½	3	7	--	1	1	3
6½	6	7	--	--	2	2
7½	12	--	2	--	5	--
8½	--	--	--	--	--	--
9½	--	3	--	--	--	1

15 fawns:94 adults = 16:100[c]
15 fawns:23 adult females = 65:100
yearlings = 22% of adult females
yearlings = 42% of adult males
30 yrlg. males:5 yrlg. females = 600:100, or 86% males
8 male fawns:7 female fawns = 114:100, or 53% males

[a]Data from checking stations and jaw collections were combined.

[b]Sample size is in parentheses.

[c]Includes animals harvested only during fall 1981.

Table 4. Percent composition by age of 68 white-tailed deer killed on highways along the Yellowstone River during the biological years 1981 and 1982.[a]

Age Class	Females 1981 (17)[b]	Females 1982 (26)	Males 1981 (8)	Males 1982 (17)	Total 1981 (25)	Total 1982 (43)
½	41	27	50	59	44	40
1½	35	23	50	41	40	30
2½	12	19	--	--	8	12
3½	--	8	--	--	--	5
4½	12	8	--	--	8	5
5½	--	8	--	--	--	5
6½	--	--	--	--	--	--
7½	--	4	--	--	--	2
8½	--	--	--	--	--	--
9½	--	4	--	--	--	2

17 fawns:26 adults = 65:100[c]
17 fawns:19 adult females = 89:100
yearlings = 32% of adult females
yearlings = 100% of adult males
7 yrlg. males:6 yrlg. females = 117:100, 54% males
10 male fawns:7 female fawns = 143:100, or 59% males

[a]Some samples within each year were from hunting districts 761 and/or 714.

[b]Sample sizes are in parentheses.

[c]Includes data only from biological year 1982.

Table 5. Percent composition by age of 39 white-tailed deer taken on depredation kill permits during January and February 1982.

Age Class	Females (27)[a]	Males (12)	Total (39)
½	52	75	59
1½	7	--	5
2½	15	17	15
3½	--	8	3
4½	4	--	3
5½	--	--	--
6½	4	--	3
7½	7	--	5
8½	--	--	--
9½	--	--	--
10½	--	--	--
11½	4	--	3
12½	4	--	3
13½	--	--	--
14½	4	--	3

23 fawns:16 adults = 144:100
23 fawns:13 adult females = 177:100
yearlings = 15 percent of adult females
9 male fawns:14 female fawns = 64:100, or 39% males

[a]Sample size is in parentheses.

Table 6. Percent composition by age of 185 white-tailed deer trapped along the Yellowstone River during 1980-82.

Age[a] Class	Females			Males			Total		
	1980 (18)[b]	1981 (27)	1982 (59)	1980 (15)	1981 (20)	1982 (46)	1980 (33)	1981 (47)	1982 (105)
½	44	26	46	87	70	78	64	45	60
1½	6	15	14	--	30	20	3	21	16
2½	17	26	19	--	--	--	9	15	10
3½	11	7	10	7	--	2	9	4	7
4½	11	7	5	--	--	--	6	4	3
5½	6	11	5	--	--	--	3	6	3
6½	--	4	2	7	--	--	3	2	1
7½	6	4	--	--	--	--	3	2	--

63 fawns:42 adults = 150:100[c]
63 fawns:32 adult females = 197:100
yearlings = 25% of adult females
yearlings = 90% of adult males
9 yrlg. males:8 yrlg. females = 112:100, or 53% males
36 male fawns:27 female fawns = 133:100, or 57% males

[a] Age was determined by an eruption and wear technique.

[b] Sample size is in parentheses.

[c] Includes animals trapped only during winter 1982.

Yearlings accounted for 20 percent of the population during fall 1981. Survival of this cohort during winter 1980-81 was high (45% of population during spring 1981), but they accounted for only 34 percent of the adult deer (1½+) in the population during fall 1981 (Table 7). Among adult females, 2½-year-olds outnumbered yearlings in samples of harvested, collected and trapped deer.

It seems likely that numbers of deer from the 1980 cohort in the population on the river bottom may have been reduced by dispersal during the period from June through November 1981. Yearlings of both sexes may have been prone to dispersing from areas in which they spent their first year, although the data indicated that more females than males may have left the river bottom (Figure 2).

Table 7. A model of population size, composition and turnover of white-tailed deer along a 53 mile stretch of river bottom from Glendive to Sidney during fall 1980 through spring 1982.[a]

Season and Year	Total Number	Age Class	Males	Females	% Fawns	% Yrlgs.	% Adults
Fall (Pre-hunt)	3552	2½+	202	855	43	25	32
1980		1½	426	462			
		½	764	763			
		Total	1472	2080			
Harvest Mortality (13%)[b]			-251 (17%)	-210 (10%)			
Early Winter	3091	2½+	205	767	45	24	31
1980-81		1½	320	421			
		½	689	689			
		Total	1214	1877			
Mortality[c] (1%)			- 10 (1%)	- 20 (1%)			
Spring	3061	2½+	205	762	45	24	31
1981		1½	315	414			
		½	685	680			
		Total	1205	1856			
Recruitment[d] (28%)			+475 (39%)	+388 (21%)			
Fall (Pre-hunt)	4317	2½+	361	1323	41	20	39
1981		1½	475	388			
		½	885	885			
		Total	1721	2596			
Harvest Mortality (13%)			-407 (25%)	-280 (11%)			
Early Winter	3756	2½+	150	1220	45	18	37
1981-82		1½	321	362			
		½	844	849			
		Total	1315	2441			
Mortality (8%)			-165 (13%)	-126 (5%)			
Spring	3465	2½+	150	1217	41	19	40
1982		1½	316	356			
		½	684	742			
		Total	1150	2315			

[a]Model was derived from a population estimate, using a Lincoln Index, during early winter 1981-82. Population estimates during other seasons and years were calculated using a change-in-ratio formula (Downing 1980) with the composition of mortality roughly known.

[b]Change-in-ratio formula used and was in agreement with tag return data.

[c]Mortality from winter to spring also included road-killed deer, which accounted for 1% of winter populations. Mortality believed influenced by malnutrition was documented only during winter 1981-82.

[d]Only 63% of the fawns of 1980, which were in the population during spring 1981, were present in the fall 1981 population as yearlings. It was likely that dispersal of some members of this cohort from the river bottom may have contributed to this discrepancy.

Data in Tables 3, 4 and 5 suggest that the male segment of the river bottom population turns over in 4-5 years, whereas the female segment turns over in excess of 9 years. Hunting mortality, which included crippling, accounted for nearly all observed and reported deaths of males older than yearlings. As in the sample of hunter-killed deer, highway mortality claimed yearling males in greater proportion than their representation in the population. Males older than yearlings did not occur in the sample of road-killed deer.

Aerial surveys during early winter indicated an increase in the proportion of fawns from fall (Table 2). This probably was an artifact of hunter selectivity for deer older than fawns. This increase was diminished by early spring. Observation of marked deer during late winter and early spring indicated that animals lost to malnutrition included mostly fawns. The observed fawn:adult ratio during early spring approximated that of the previous fall (Table 2).

Harvest mortality during fall 1981 claimed 12.9 percent of the white-tail population along river bottom lands from Glendive to Sidney as determined from a change-in-ratio formula (Downing 1980). From this formula, which considered the change-in-ratio of fawns:adults from fall to winter as a result of hunter selectivity for adult deer, it was determined that 4.4 and 18.8 percent of the fawns and adults, respectively, had been removed from the population by hunting during fall 1981. The proportion of radio-collared adults removed (19.2%) or lost through crippling, was in close agreement with the proportion calculated from the change-in-ratio formula. Approximately 81 percent of the fawns of fall 1981 survived through spring 1982 (Table 7). Recruitment (41%) was only slightly less than that observed the previous year (Table 2) despite more severe winter weather in 1981-82 (Table 1).

Productivity

Observed fawn:doe ratios during fall have approached or exceeded 100:100 since 1978 (Table 2). Aerial observations during fall 1981 indicated that 60 percent of the adult females (1½+) successfully reared fawns to that period (Table 8). This compared to 68 percent in 1980, although the ratio of fawns:producing female (154:100) was the same both years. This resulted in a calculated fawn:doe ratio of 92:100 for fall 1981 as compared to the observed ratio of 96:100 (Table 2). The number of fawns:producing female had declined from summer to fall (Table 8) suggesting some postnatal mortality had occurred. During the September-October period, approximately half the females with fawn(s) at heel were accompanied by singletons (Table 8).

Table 8. Productivity of adult white-tailed females on the Yellowstone River during 1980-81.[a]

Period	Fawns:100 Producing Females		Percent Ad. Females Producing	Percent of pro-during females w/ Singles	Twins	Triplets
September-October 1980	154:100	(133)[b]	68	47[c]	51	2
July-August 1981	162:100	(101)	--	41	57	3
September-October 1981	154:100	(123)	60	51	43	6

[a]Sample obtained from Elk Island, Seven Sisters and Intake study areas.

[b]Producing female sample size in parentheses.

[c]Percent of producing females.

Fawning success was determined for 25 individually marked females (Table 9) of which 23 were equipped with transmitters. None of the 3 radioed yearling females in 1981 produced fawns, whereas 80, 100 and 86 percent of the respective females aged 2½, 3½-5½ and 6½+ years successfully reared fawns to fall 1981(Table 10). A doe:fawn ratio, calculated from the differential productivity by age class among marked females (93:100), was comparable to those determined from the population at large.

Reproductive success was determined for 30 marked females during 1980 and/or 1981 (Appendix Table 16). Fawning success was determined for 5 deer during both years. Two, which were 4½+ years in 1980, produced twins both years, while another of similar age produced a single in 1980 and twins during 1981. Two animals, which were yearlings in 1980, produced no fawns in 1980, but in 1981 one produced twins and the other a single. During summer 1980, one yearling female was observed to have successfully reared a fawn (Dusek 1981).

Table 9. Net productivity of adult female white-tailed deer (1½+) during 1981 as determined from observation of individually marked females during late summer and early fall.

Age Class	Number of Females	Percent Obs. w/ Fawns	Percent[a] Multiple Births	Number of Fawns Produced	Fawns: 100 Prod. Females	Fawns: 100 Females
1½[b]	3	0	--	--	--	--
2½	5	80	50	6	150:100	120:100
3½-5½	10	100	50	14	140:100	140:100
6+	7	86	33	9	150:100	129:100

[a]Expressed as a percent of only females successfully producing fawns.

[b]Yearlings in the sample included only transmittered deer.

Table 10. Contribution by age class to net production during 1981 based on differential productivity of individually marked females and on pre-hunt herd composition as determined from aerial composition surveys and age data of harvested deer.

Age Class	Composition per 100 Adult Females	Number of Fawns Produced	Calculated from Data in Table 8	Observed in[a] Pop. during October 1981
1½	21	0		
2½	26	31		
3½-5½	40	56		
6+	5	6		
Fawns:100 Ad. Females	---------	93:100	92:100	96:100

[a]Data also appears in Table 2.

Prenatal Productivity

Reproductive tracts of 34 female white-tailed deer, collected from January-April 1982, were examined. Only 2 of 9 fawn females examined were pregnant. One carried a single fetus, and the other twins. All females older than fawns were pregnant.

Females with an assigned age of 2½-4½ (3-5 at fawning) were the most productive age classes, followed by those 5½+ and yearlings, respectively (Table 11). Females 2½+ had much higher ovulation indices but lower fertilization rates than yearlings. A combined sample of females 1½+ during winter and spring 1982 had an ovulation index of 2.11 and a fertilization rate of 87 percent. When comparing the number of young: producing female and the proportion of multiple births among producing females in Tables 8 and 11 (both prior to and following fawning), some fetal loss and/or early post natal fawn mortality apparently occurs. A conservative estimate of such mortality, not taking into account females that lost all fawns they produced, was 18 percent. This is based on the assumption that the number of fawns:producing female differs very little from year to year.

Table 11. Prenatal productivity of white-tailed deer by age class from analysis of reproductive tracts of 26 pregnant females during winter and spring 1982.

Age Class	Ovulation Index	Fertilization Rate (%)	No. Fetuses: Preg. Fem.	Fetal Sex Ratio(♂'s:♀)	% Mult. Births
½	1.50 (2)[a]	100	1.50 (2)	--	--
1½	1.25 (4)	100	1.43 (7)	4.0	43
2½-4½	2.37 (8)	89	2.20 (10)	0.9	90
5½+	2.33 (6)	79	1.86 (7)	1.0	86
Total (1½+)	2.11	87	1.87	1.2	75

[a]Number of specimens per age class are in parenthese.

Yearling females produced a preponderance of male fetuses whereas older females produced a fetal sex ratio of nearly 1:1 (Table 11). Similar findings were reported by Dapson et al. (1979) and Ozoga and Verme (1982).

Population Trend

During early winter 1981-82, the population between Glendive and Sidney was estimated to number 3,756 deer as determined from the proportion of transmittered deer observed during a complete aerial census. Considering that approximately 13 percent of the population was removed by hunting, the calculated pre-hunt population was about 4,317 deer. This represented a 22 percent increase over the estimated pre-hunt population for the previous year (Table 7). These total population estimates are crude since radioed deer were not uniformly distributed but concentrated in and near the 3 units of intensive study (Figure 3). Radioed deer also accounted for less than 1 percent of the estimated population.

Population estimates were made during March and April 1982 for both the Elk Island and Intake study units. Population estimates of 482 and 421 deer for the respective units were an average of estimates from the 2 census flights in each unit. Calculated 95% confidence intervals, using the multiple aerial sampling technique of Rice and Harder (1977), were 408-556 for Elk Island and 413-429 for Intake. During observability conditions characterized by clear skies and lack of snow cover and when deciduous riparian vegetation was leafless, the proportion of marked deer observed varied from 33-36 percent at Elk Island (5 census flights) and 43-60 percent at Intake (4 flights). The difference in observability between the 2 units may have reflected lesser abundance of understory shrub cover in the Intake study unit as influenced by grazing. Early spring appeared the most optimal period to census these units because 1) each area contained maximum yearly numbers of marked deer and 2) it was assumed that animals were not moving in or out of the area and the whereabouts of marked deer was generally known.

Approximately 12 percent of the population in the Elk Island study unit was marked as of spring 1982. The population estimate for spring 1982 was approximately 19 percent higher than that for spring 1981. This was about the same percentage increase as estimated for the entire study area from fall 1980 to fall 1981 (Table 7).

Animal density was estimated at 58 deer/mi^2 at Elk Island and 40 deer/mi^2 at Intake during spring 1982. Densities calculated for the same period of 1981 were 49 and 45 deer/mi^2, respectively (Dusek 1981).

Condition

Field-dressed weights of hunter-harvested white-tailed deer from the lower Yellowstone River are summarized in Table 12. Average dressed weights of both sexes of fawns and yearling females from the Yellowstone were comparable to state-wide averages for the respective sex and age classes (Mackie 1964) and to averages for the Swan Valley of western Montana (Mundinger 1981).

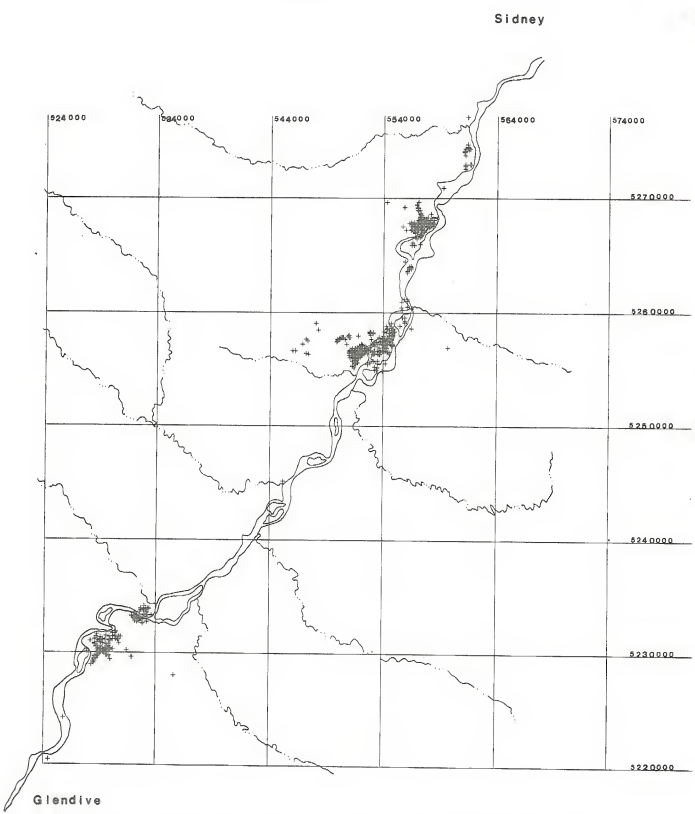

Figure 3. Yearlong distribution of transmittered deer on the lower Yellowstone River from June 1980 through February 1982.

Weights of yearling males from the Yellowstone were comparable to those for the Swan but averaged approximately 15 pounds heavier than the state-wide sample. Deer of both sexes, which were older than yearlings, from the Yellowstone were of comparable weight to the state-wide sample but averaged 10-12 pounds less than the corresponding sex and age classes from the Swan.

Table 12. Average field-dressed weights, by sex and age, of 37 white-tailed deer harvested in the Yellowstone Valley during 1980-81.

Age Class	Weight (Lbs.) Females	Males
½	57 (5)[a]	60 (2)
1½	92 (6)	115 (14)
2½	--	135 (4)
3½	90 (1)	152 (11)
4½	102 (2)	200 (1)
5½	--	--
6½	105 (1)	--

[a]Sample size is in parentheses.

Habitat Use

Distribution

White-tailed deer on the lower Yellowstone occurred primarily in sections of river bottom which were characterized by a braided stream channel and where the entire spectrum of young to old seral communities, as described by Boggs (1981), was represented. Bottomlands dominated by late seral to climax communities appeared devoid of deer. Observations and relocations of marked deer, as well as observation of unmarked deer, suggested that seasonal changes in distribution were negligible, although some individuals differentially used portions of their annual home range by season.

There appeared to be a marked difference between diurnal and nocturnal patterns of habitat use. Deer appeared to use a wider range of available habitat during periods of twilight and darkness than during periods of daylight when they restricted their activity to relatively dense deciduous riparian cover. The circadian aspect of habitat use will receive major emphasis during the next 2 years.

Seasonal and Annual Home Ranges

Summer and/or winter home ranges were computed for 29 radio-collared deer (1½+ years) during the biological year, 1981-82 (Table 13). The sample included 23 females and 6 males. Six of the adult females were also monitored during the preceeding year. The data summarized in Table 13 included only activity during daylight and twilight periods. Early morning, midday and evening periods accounted for 36, 37 and 27 percent of all relocations.

Data from radio-collared deer indicated a high affinity for relatively small areas during summer and winter. This was particularly obvious among adult females (Table 13). Home ranges of summer 1981 averaged 0.17, 0.07 and 0.05 mi^2 for females aged 1½, 2½ and 3½+, respectively. One 2½-year-old female (81-30) moved approximately 9 miles upstream during June 1981, where she remained for 2-3 weeks before returning to her original home range and was not included in the above sample. Summer home ranges averaged 1.31 and 0.20 mi^2 for males aged 1½ and 2½, respectively (Table 13). The average winter home range for all adult females during 1981-82 was 0.09 mi^2 and 0.19 mi^2 for 2 yearling males.

A fidelity index, which represents the distance between geometric centers of activity for a given season over a period of 2 or more years for individual animals, was computed for females fallowed since the spring of 1980. This index serves as a means of quantitatively measuring the relative fidelity that individuals have for seasonal or annual home ranges where 0 represents complete fidelity. The sample of deer included 6 adult females for summer and 5 adult females during fall and winter. Average indices for seasonal samples were 0.15, 0.16 and 0.21 during summer, fall and winter, respectively, which suggested that adult females have a higher affinity to summer home ranges from year to year than they have for other seasonal ranges. Differences between age classes were not detected among the small sample. The standard deviation from the means of seasonal samples were 0.02, 0.12, and 0.06 during summer, fall and winter, respectively, which perhaps indicated that these females not only had a high affinity to certain areas during summer as compared to other seasons, but that this trend appeared consistant among females generally. It is not uncommon for some individuals to use non-overlapping portions of their annual home range during summer and winter, while those portions used during fall and/or spring may not be common to either summer or winter home ranges. Such a pattern was observed for one adult female

(80-08) (Dusek 1981) during both years she was monitored.

Of the 6 females monitored since June 1980 (those from which fidelity indices were computed), 2 were yearlings in 1980 and neither produced fawns that year. Both produced fawns in 1981, while the 4 older does were known to have successfully reared fawns both years. The 2 younger females in the sample apparently had established permanent summer home ranges as yearlings.

Table 13. Seasonal and annual home ranges of transmittered white-tailed deer captured on the Yellowstone River prior to June 1981.

Serial Number	Age at Capture	Study Area[a]	Home Range Size (mi^2) Summer 1980	Summer 1981	Winter 1980-81	Winter 1981-82	Annual[b] 1980-81
			Females				
80-02**	2½	1	0.14	--	--	--	--
80-03	4½	1	0.05	0.01	0.11	0.07	0.96
80-05*	½	1	0.19	--	0.30	--	--
80-06	4½	1	0.05	0.05	0.09	0.12	0.16
80-08	3½	1	0.03	0.01	0.73	0.09	2.41
80-10*	½	1	0.25	0.02	3.39	--	9.26
80-12	3½	1	0.08	0.10	0.54	0.16	0.63
80-17*	½	1	0.07	--	--	--	--
80-19*	2½	1	0.06	--	--	--	--
80-20*	1½	2	0.10	--	--	--	--
80-26+	7½	2	--	0.03	0.14	--	--
80-29	½	2	0.09	0.03	0.09	0.06	0.38
81-01	1½	2	--	0.06	--	0.08	--
81-04	2½	2	--	0.02	0.05	0.03	--
81-05*	5½	2	--	0.03	--	--	--
81-13	2½	1	--	0.05	--	0.23	--
81-18	2½	1	--	0.12	--	0.20	--
81-24*	2½	2	--	0.02	--	--	--
81-29	6½	3	--	0.10	--	0.07	--
81-30	1½	3	--	3.65	--	0.06	--
81-32**	6½	3	--	0.02	--	--	--
81-34	½	3	--	0.23	--	0.03	--
81-37	2½	3	--	0.05	--	0.16	--
81-38**	9½	3	--	0.08	--	0.10	--
81-39+	1½	3	--	0.17	--	--	--
81-41	½	3	--	0.04	--	0.02	--
81-42**	½	3	--	0.24	--	--	--
81-45**	2½	3	--	0.04	--	0.04	--
			Males				
80-22*	3½	2	0.12	--	--	--	--
80-27*	6½	2	0.05	--	--	--	--
81-03*	1½	2	--	0.07	--	--	--
81-10	½	1	--	0.61	--	0.33	--
81-14*	1½	1	--	0.36	--	--	--
81-08*	1½	2	--	0.18	--	--	--
81-23*	½	2	--	0.05	--	--	--
81-36	½	3	--	3.27	--	0.06	--

[a]Study areas: 1 - Elk Island; 2 - Seven Sisters; and 3 - Intake.
[b]Biological year - June 1 - May 31.
* Animal lost to the population through hunting mortality.
**Animal lost to the population by mortality other than hunting.
+ Transmitter failure.

Movements and Dispersal

Of 43 deer marked during winter/spring 1980-81, 9 (21%) were known to have dispersed from their capture sites between June and November 1981 (Table 14). It was unlikely that most of this observed movement was attributable to routine travel between winter and summer home ranges. The maximum distance travelled between the respective home ranges among the sample of marked deer was 2.6 miles (a transmittered adult female, 81-04).

Table 14. Summary of known dispersals of marked white-tailed deer during the biological year ending May 31, 1982.[a]

Serial Number	Sex	Age[b]	Origin[c]	Destination	Dist. Trav. (mi)	Status
+81-10*	M	1½	Elk Isl.	Sev. Sis.	7	Permanent
81-21*	M	1½	Elk Isl.	Sev. Sis.	6	Cripp. Loss
81-22	F	2½	Elk Isl.	Lambert	19	Harvested
+81-23	M	1½	Sev. Sis.	Gartside Res.	2	Harvested
+81-26	M	1½	Sev. Sis.	Elk Isl.	6	Harvested
81-27	F	1½	Elk Isl.	near Sidney	14	Permanent
+81-30	F	2½	Intake	Near Glendive	9	Temporary
81-35	M	1½	Intake	Box Elder Cr.	4	Temporary
81-36	M	1½	Intake	Box Elder Cr.	4	Harvested

[a] Includes 9 marked animals, which were captured during winter/spring 1981, which were known to have dispersed from the area where they were captured from June through November 1981.

[b] Age as of June 1, 1981.

[c] Study unit in which animal was marked.

+ Individual was transmittered.

* Offspring of transmittered females.

Yearlings accounted for 7 (78%) of the 9 animals with abberrant patterns of movement (Table 14). Four of the 7 yearlings were killed during the hunting season of 1981 (one was a reported crippling mortality). Of the survivors, a transmittered male (81-10) remained in the immediate vicinity of Seven Sisters Island after moving there in November 1981 from an area just north of Elk Island where he had spent the preceding summer (Figure 4).

He was the 1980 fawn of transmittered female 81-13 which has remained on the Elk Island Management Area since being captured in January 1981. He became disassociated from her in late June 1981. The known crippling loss (yearling male, 81-21) was the 1980 fawn of transmittered female 80-06 which has remained in the Elk Island Management area since she was captured in March 1980. Yearling male 81-21 was found dead by a hunter near Seven Sisters Island during late November 1981.

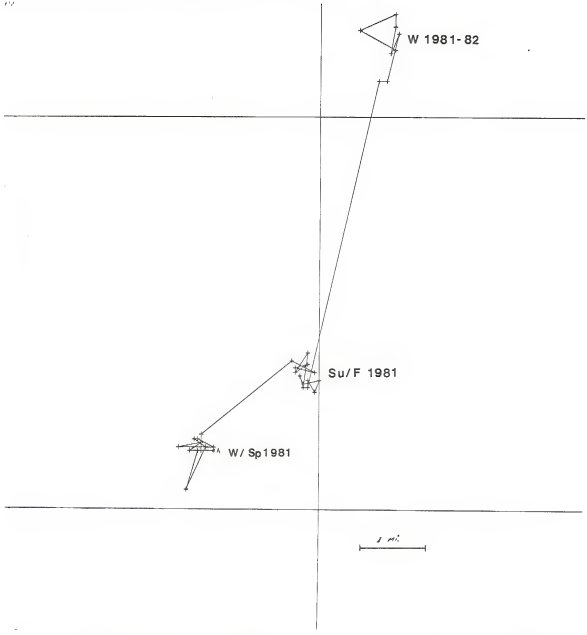

Figure 4. Movements of a transmittered male white-tailed deer from February 1981 (fawn) through February 1982 (yearling).

A yearling female, collared as a fawn near Elk Island during February 1981 (81-27), moved into a "deer-proof" game farm enclosure near Sidney during late May to early June 1981. This was a straightline distance of 14 miles from the point of capture. She was observed within the enclosure on 2 occasions. The remaining survivor, a male (81-36) was captured on the Gentry ranch near Intake and equipped with a transmitter collar in March 1981. He and a collared sibling (81-35) were observed along the floodplain on 3 occasions prior to June 1981. Both were observed in the Box Elder Creek drainage during early June 1981 as yearlings. Animal 81-36 returned to the river bottom by mid-June and 81-35 was not observed until he was killed by a hunter on the west side of the river near Intake in November 1981.

The 2 marked deer older than yearlings, that moved more than 2 miles from their respective capture sites, were both 2½-year-old females. One female (81-30), which was equipped with a transmitter on the Gentry ranch in March 1981, moved 9 miles up river near Glendive during early June 1981 but returned to Gentry's by mid-July. She did not successfully rear a fawn during 1981. The other 2½-year-old female (81-22) was collared at Elk Island in February 1981 and was last observed in that area in May 1981. She was taken by a hunter near the community of Lambert, Montana during November, a distance of approximately 19 miles from where she was marked.

Only one of 10 males of the 1979 cohort, which were collared at Elk Island during Feb./Mar. 1980 (Dusek 1981), was observed during the report period. That was a 2½-year-old (80-04) when observed on the Gentry ranch during August 1981, a distance of 22 miles from Elk Island. He was not observed during the year following his capture and was assumed to have left the Elk Island area during summer 1980. A sighting was made in April 1982 of a collared deer with the same combination of colors in the Intake study unit but could not be positively identified due to deterioration of the collar. The greatest reported distance from which one of the 10 collared males of the 1979 cohort was observed from Elk Island was 28 miles; it was sighted by a hunter near Glendive in November 1980.

Nearly all known dispersal during June was likely related to break-up of family groups when adult females separate themselves socially and spatially prior to giving birth as reported by Hawkins and Klimstra (1970). Downing and McGinnes (1975) reported a tendency for 2-year-old females to move long distances when preparing to bear their first fawn. Long movements by yearling males during November generally coincided with the rut and heavy hunting pressure where affected animals were located (81-10 and 81-23).

Harvest

Harvest data for hunting district (h.d.) 750, which includes the study area, are summarized in Table 15. Approximately 90 percent of the white-tailed deer in h.d. 750 occurred along bottomlands of the Yellowstone River during winter 1978-79 (Swenson 1980).

Table 15. Summary of harvest statistics for deer hunting district 750 as determined from the statewide postseason harvest survey.[a]

Year	1976	1977	1978	1979[d]	1980	1981
Total hunters[b]	1224	1318	1319	1136	1383	1858
% of Harvest WT Deer	96	88	67	75	76	77
No. of WT Deer Harvested	594	527	462	458	624	810
% of Total WT Harvest Antlered	70	81	71	67	69	68
% of WT Harvest B-tag Antlerless	--	--	--	11	15	12
Percent Success	53	46	49	54	59	57

[a]Data for the years of 1976-80 were obtained from a questionnaire, whereas a telephone survey was used during 1981.

[b]Includes all hunters regardless of species hunted.

[c]Includes all hunters regardless of species harvested.

[d]The hunting district was decreased in size by a boundary change in 1979 which excluded portion of Beaver Cr. in Wibaux County. B-tags (antlerless) were issued in HD 750 from 1979-81.

A comparison of estimated hunting mortality (including crippling losses) on the river bottom from 1980-81 (Table 7) with numbers of whitetails harvested in the entire hunting district from the statewide post-season survey for the same years (Table 15) suggested that numbers of whitetails harvested in prairie and stream bottom habitats adjacent

to the river accounted for proportionately more than 10 percent of the total harvest for h.d. 750. Estimates of hunting mortality of 461 and 687 during 1980 and 1981, respectively, accounted for 74 and 84 percent of the total harvest for the hunting district during the respective years. Populations of white-tailed deer in upland prairie habitats in eastern Montana have increased noticeably since 1979 (N. Martin, J. Swenson, personal communication). They may have increased at a rate greater than those on the river bottom. Whitetails in prairie habitats may also be more vulnerable to hunting mortality than those in forested river bottom habitat. Swenson (1982) reported such a phenomenon for mule deer.

Numbers of white-tailed deer harvested in h.d. 750 has steadily increased since 1979 (an average of 33% per year). The proportion of antlered males in the harvest was consistant (ave. 68%±1) after the latest h.d. boundary change in 1979. Antlered whitetails accounted for 55 and 62 percent of those taken on the river bottom study area as determined from hunter checking stations. Swenson (1980) reported a discrepancy between the proportion of antlered deer examined at checking stations and that reported by hunters on the questionnaire which was likely attributable to some reporting male fawns as antlered deer. Using his correction factor of 0.08, the harvest of antlered whitetails in h.d. 750 averaged 54 percent from 1979-81.

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Submitted by: Gary L. Dusek

Appendix Table 16. Reproductive history of 28 individually marked white-tail females on the Yellowstone River.

Serial Number	Estimated Age At Capture	Number of Fawns Produced 1980	1981
80-02*	2½+	2	
80-02*	4½+	2	2
80-05*	½	0	?**
80-06*	4½	2	2
80-08*	3½	1	2
80-10*	½	0	2**
80-12*	3½	?	2
80-17*	½	1	
80-19*	2½	2	
80-20*	1½	?	
80-26*	7½	?	1
80-29*	½	0	1
81-01*	1½		1
81-04*	2½		2
81-05*	4½		3
81-13*	2½		1
81-18*	2½		1
81-20	5½		1
81-24*	4½		1
81-29*	6½+		1
81-30*	1½		0
81-32*	6½		0
81-34*	½		0
81-37*	2½		1
81-38*	5½		1
81-39*	1½		2**
81-41*	½		0
81-42*	½		0
81-44	4½		1
81-45*	2½		2

* Animal was equipped with a transmitter.
** Transmitter failed during late summer period when data were being collected.

STUDY NO. BG-2.0 JOB NO. 5

JOB TITLE The relationship of white-tailed deer and mule deer to agriculture in the Gallatin Valley.

JOB OBJECTIVES

1. To determine basic biological and ecological parameters for an erupting population of white-tailed deer in the Gallatin Valley, Montana.
2. To relate those basic population parameters to (2) habitat/environmental characteristics of the Gallatin Valley and (b) specific potential limiting factors for deer in that habitat, including nutrition, other wild ungulates, specifically mule deer, agriculture and associated farming practices, domestic livestock and associated grazing practices, rural subdivisions and associated human activities, weather, disease, and hunting.
3. To further develop and test hypotheses relating to deer-habitat interactions and populations regulation; and
4. To develop guidelines for deer management on mountain valley/agricultural habitats.

INTRODUCTION

This project involves the study of the ecology of white-tailed deer and mule deer and their relations to agriculture and development in the Gallatin Valley, Montana. The study area and general methods employed were described in a previous report (Vogel and Picton 1981). Field studies were conducted from April 1981 through June 1982. This report summarizes activities and findings for the period July 1, 1981 - June 30, 1982. Data will be compiled analyzed and reported in a final report to be submitted by January 1983.

RESULTS

Sixteen deer were monitored during the entire year. An additional 30 were marked from January to March of 1982, released and monitored during the winter and spring. A maximum of 45 deer are still marked in the valley, as one recognizable animal shed its collar. At present there are 16 deer with radio transmitters. The details of those deer marked in 1982 are given in Tables 1 and 2. Information on those caught in 1981 was given in a previous report (Vogel and Picton 1981).

Table 1. White-tailed deer captured and marked in the Gallatin Valley during February and March of 1982

Area	Sex	Age	Date	Radio Freq.	Collar
Penwell	F	½	2/14/82		Yellow open circles on blue
50727-4903	F	1½	2/16/82	150.200	Black zig-zag on white
	M	2½	2/18/82		White arrows on red
	F	2½	2/24/82	150.600	Black squares on white
	M	½	2/25/82		White open triangles on red
	M	1½	2/26/82		Black double plus on white
	F	1½	2/27/82	150.100	Solid black
	M	1½	3/3/82		Black sigma on white
	*F	3½	3/3/82		Yellow M on blue
	F	3½	3/4/82		Yellow dots on blue
	M	½	3/2/82		Ear tags only
Sourdough	F	½	2/13/82		Yellow circles on blue
50496-4976	F	3½	2/24/82	150.150	Solid white
	F	½	2/24/82		Yellow bars and dashes on blue
	F	1½	2/25/82	150.550	Black double dashes on white
	M	½	2/25/82		Black diamonds on yellow
	M	½	3/1/82		Black stripe on yellow
	M	1½	3/1/82		Black dashes on yellow
	F	1½	3/6/82		Black bars on yellow
	M	½	3/6/82		Black triangles on yellow
	F	1½	3/9/82	150.650	Yellow double dashes on black

* potential hybrid

Table 2. Mule deer captured and marked in the Gallatin Valley from January to March of 1982.

Area	Sex	Age	Date	Radio Freq.	Collar
Valley	F	2½	1/19/82	150.500	Solid red
Center	F	½	1/19/82		Yellow diagonals on blue
50632-4878	F	½	1/20/82		Yellow sin wave on blue
	M	½	1/20/82		White dashes on red
	F	2½	2/4/82	150.300	Yellow stripe on red
	F	8½	2/5/82	150.250	Yellow and red chevrons
	M	2½	2/8/82		White circles on red
	M	½	3/5/82		Red circles and stripe on white
	F	3½	3/8/82	150.450	Black dots on white

Movements in the late spring for deer radioed in 1981 were the same in both years and indicate distinct summering and wintering areas. Dispersion was also seen in those deer marked in 1982.

On August 21, 22,23 of 1981 an extensive fixed wing survey was conducted, 362 deer were observed. White-tailed deer had 98 fawns per 100 adult does and mule deer had 56.

Several of the road kill deer that were necropsied, appeared to be hybrids, according to the description given by Wishart (1980). Protein-electrophoresis is being employed to further test for this possibility.

Observations on the distributions, movements, habitat use, activity habitats and population characterstic of deer will be analyzed and related to distribution of land use types and other habitat characteristics in the final report.

Landsat imagery was used to develop a procedure for estimation of the percent snowcover in the valley from the snow on ground measurements at the Montana Agricultural Experiment Farm Weather Station.

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A LIST OF PUBLICATIONS RESULTING FROM
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